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UNITED STATES GOVERNMENT

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Mar. 30, 1917
From the
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H. O. No. 160.

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FROM THE

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U.S. - Hydrogenolysis

H. O. No. 160

BAY OF BENGAL PILOT

BAY OF BENGAL AND THE COASTS
OF INDIA AND SIAM, INCLUDING THE
NICOBAR AND ANDAMAN ISLANDS

PUBLISHED BY THE HYDROGRAPHIC OFFICE
UNDER THE AUTHORITY OF THE
SECRETARY OF THE NAVY



WASHINGTON
GOVERNMENT PRINTING OFFICE
1916

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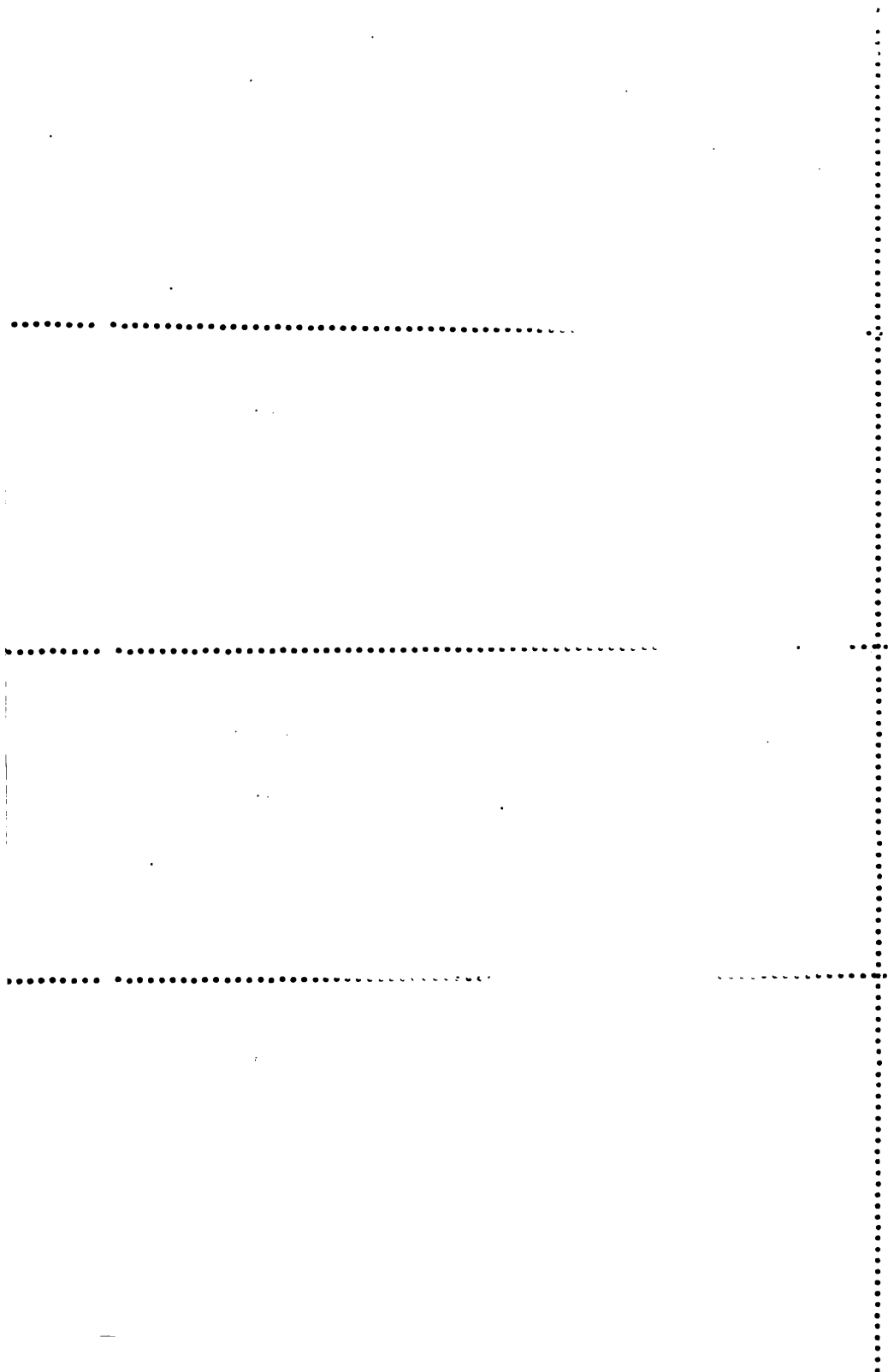
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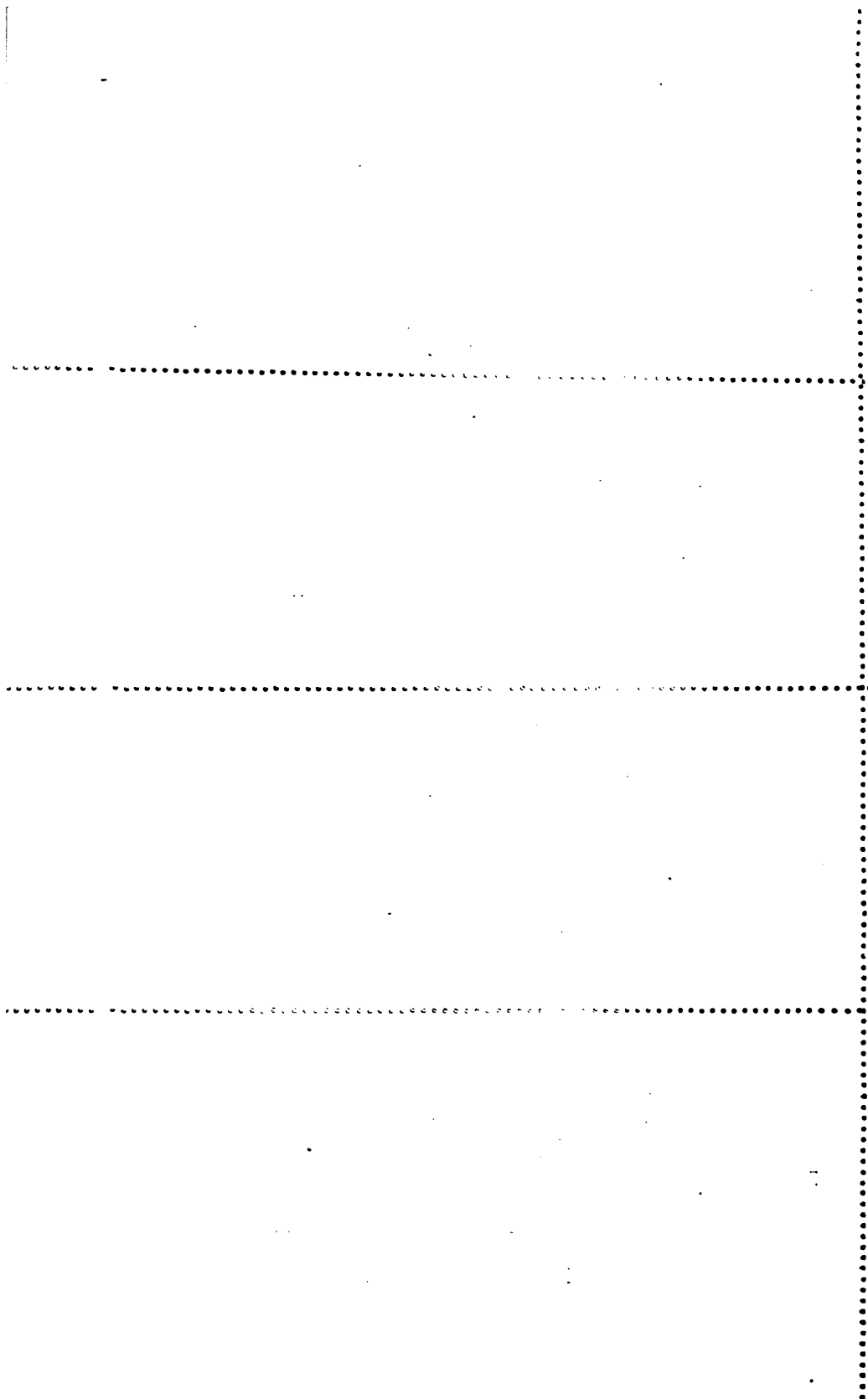
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CONTENTS.

	Page.
Preface.....	9
Glossary.....	5
Compass.....	7
Information relating to navigational aids and general navigation.....	11
Index.....	463
Index chart.....	Faces 9
CHAPTER I.	
General information.....	31
CHAPTER II.	
Calimere Point to Cocanada.....	117
CHAPTER III.	
Orissa Coast—Cocanada to False Point and Dhamra River	155
CHAPTER IV.	
Balasore, Sundarbans, and Chittagong Coasts, with the Hugli, Matla, and Meghna Rivers.....	189
CHAPTER V.	
Coasts of Arakan and Burma—Elephant Point to Cape Negrais.....	235
CHAPTER VI.	
The Nicobar, Andaman, and Coco Islands.....	273
CHAPTER VII.	
Preparis Channels and the Gulf of Martaban to Tavoy River.....	333
CHAPTER VIII.	
Coasts of Tenasserim and Siam—Tavoy River to Salang Island, including the Mergui Archipelago and Brothers Islands.....	399
Appendix I.—Dry docks, patent slips, etc.....	458
Appendix II.—Wet docks, basins, locks, etc.....	460
Appendix III.—Depths in principal ports, etc.....	461

Glossary of a few terms which may be found useful.

Numerous languages and dialects are used on the various coasts described in the Bay of Bengal Pilot. On the shores of Palk Bay the language is Tamil or Malayalam; this gives way to Telugu, north of Madras, Oriya, north of Puri, and Bengali from the Hugli River to the Burmese frontier. Hindustani is, however, very generally used on the east coast of India. On the eastern side of the Bay of Bengal Arakanese, Burmese, and further southward, Malay, are spoken. The natives of the Nicobar Islands use different dialects at the various islands of the group, none of which have been written, but that of Car Nicobar is best known; in the Andaman Islands, also, the dialects are many.

English.	Tamil.	Hindustani.	Bengali.	Burmese.	Malay.
Anchorage.....	Kuda.....	Langer-wara.....	.....	.....	.....
Bay.....	Toni vallam kattai.....	Kol.....	.....	.....	Telok.
Boat.....	.....	Baglia.....	.....	.....	Jalur, prosa.
Boundary.....	.....	.....	.....	.....	.....
Canoe (outrigger).....	.....	Nakhuda.....	.....	.....	.....
Captain.....	.....	Bharti.....	.....	.....	.....
Cargo.....	Chamnan.....	Kinara.....	.....	.....	.....
Coast.....	.....	.....	.....	.....	.....
Coco nut.....	.....	.....	.....	.....	.....
Coco nut, young.....	.....	Nadi, nullah.....	Khal.....	Galit.....	Jurang, churan.
Communication.....	.....	Chauki.....	.....	Chaung.....	.....
Creek.....	Paku, aluppanti.....	.....	.....	.....	.....
Cuscombouse.....	.....	.....	Vadi, braidya.....	.....	.....
Dangerous for boats.....	.....	.....	.....	.....	.....
District.....	Dakrittai.....	Hakim.....	.....	.....	.....
Doctor.....	.....	.....	.....	.....	.....
European man.....	.....	Khula-din.....	.....	.....	.....
Fine weather.....	.....	Machhlo.....	.....	.....	.....
Fish.....	.....	Machhwa.....	.....	.....	.....
Fisherman.....	Kodi maram.....	.....	.....	.....	Labuan.
Flagstaff.....	.....	.....	.....	.....	Gadong.
Flat country.....	.....	Khana.....	.....	.....	Pulau, pulo, goh, koh.
Food.....	Turai muka.....	Bandar.....	.....	.....	.....
Garden or plantation.....	.....	.....	.....	.....	.....
Harbor.....	Védu.....	.....	.....	.....	.....
Hill.....	Kucil.....	Jingra, dip, lanka.....	.....	Gyun.....	Danau (asik).
House.....	.....	.....	.....	.....	.....
Hut.....	.....	.....	.....	.....	.....
Island.....	Kadu.....	.....	.....	.....	.....
Jungle.....	.....	.....	.....	.....	.....
Lagoon, fresh water.....	.....	.....	.....	.....	.....
Lagoon, salt water.....	.....	.....	.....	.....	.....
Lake.....	.....	Jhil.....	.....	In.....	.....
Land.....	.....	Zamin.....	.....	.....	.....
Landing place for canoes.....	.....	.....	.....	.....	.....
Land wind.....	.....	.....	.....	.....	.....
Man of war.....	.....	.....	Ganj.....	.....	.....
Market town.....	Mala.....	.....	.....	.....	Pakau, pasar.
Mountain.....	.....	.....	.....	.....	Gumong, gle.
Mountainous country.....	.....	.....	.....	.....	Kwala, kuala.
Mouth of river.....	Mukattuvaram.....	Nabin.....	.....	.....	.....
No.....	.....	.....	.....	.....	.....

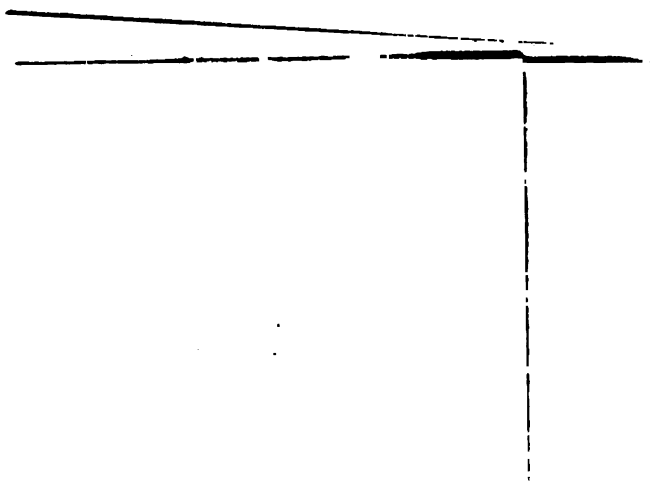
Glossary of a few terms which may be found useful—Continued.

6

English.	Tamil.	Hindustani.	Bengali.	Burmese.	Malay.
North wind.....					
Northeast monsoon.....					
Oar.....		Dand.....			Lapong.
Opening.....				Wa.....	
Pigoda.....				Kyeung.....	
Pilot.....		Manjhi.....			
Point of land.....	Munsal.....	Karh.....			
Provisions.....	Jin chāmān.....	Khans.....			Ujong, tanjong.
Rain.....		Mohh.....			
Reef coral.....					
Reef, rocky.....					
Rice (cooked).....		Bhat.....			
River.....		Karl, Nedi, Ganga.....			
River mouth.....	Aru, ar.....	Rasta.....		Myit.....	Batang, sungl.
Road.....		Chatan.....			
Rock.....	Kallō, kal.....				
Rocky bay.....	Kal kudda.....				Batu, trumbu.
Rocky point.....	Kal munsal.....				
Sail to.....		Pal.....			
Sail.....		Charna.....			
Sand bank.....		Khalasi.....			
Sandy beach.....		Batu danda.....	Char.....		Beting.
Sea calm.....		Kala pail.....			
Sea breeze.....					
Sea shore.....	Kedat karal.....	Kinara.....		Nego.....	Kechil.
Small.....		Chota.....			
Soldier.....		Sipahi.....			
Southeast monsoon.....					
South wind.....		Dakhana.....			
Steamer.....					
Store.....	Ahai, kadidal.....				
Swirl, heavy.....					
Tea plantation.....		Bara gam.....		Myo, daung.....	Nagri, kedol.
Town.....	Maram.....				
Valley.....		Chota gam.....		Yua.....	Kampong.
Village, large.....					
Village, small.....		Pand.....			
Village, small.....		Pawan.....			
Wine, drinking.....	Kattu.....	Han, hai.....			
Wind.....					
Yet.....					

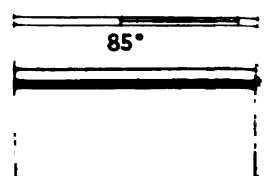
The compass.

English.	Hindustani.	Bengali.	Burmese.	Malay.
North.....	Gi wijau choki.	Uttā.	Miauk.	Útāra.
North by east.....	Gi wijau choki.	Uttā ek nishan kona.		Útāra sa-māta timor.
North-east by north.....	Gi wijau tir.	Uttā do nishan kona.		Timorlaut or utāra Timor.
North-east.....	Gi wijau arkrōp.	Nishan kona.	Ashi Miauk.	Timor sa-māta ttāra.
East-northeast.....	Gi wijau arkrōp wijau choki.	Mutlu tin nishan kona.		Timor or timor tapat.
East by north.....	Mutli dau choki.	Mutlu do nishan kona.	Ashi.	Timor tangāra or menoungāra.
East.....	Mutli.	Purub mutlu.		Tangāra or menoungāra.
East-southeast.....	Mutli wijau choki.	Mutlu ek suli mutlu.		Salātan menoungāra.
Southeast by east.....	Suli dau arkrōp dau choki.	Mutlu do suli mutlu.		Salātan.
Southeast.....	Suli dau arkrōp.	Suli tin suli mutlu.	Ashi-Taung.	Salātan dāya.
Southeast by south.....	Suli dau arkrōp wijau choki.	Suli do suli mutlu.		Bārat dāya.
South-southeast.....	Suli dau tir.	Suli ek suli mutlu.		Bārat sa māta salātan.
South by east.....	Suli dau choki.	Suli.	Taung.	Bārat or bārat tapat.
South.....	Suli.	Suli ek suli kibu.		Bārat sa-māta ttāra.
South by west.....	Suli wijau choki.	Suli do suli kibu.		Bārat laut.
South-southwest.....	Suli wijau tir.	Suli tin suli kibu.		Útāra bārat laut.
Southwest.....	Suli wijau arkrōp.	Suli kibu ukurub.	Anaut Taung.	
Southwest by west.....	Suli wijau arkrōp wijau choki.	Kibu tin suli kibu.		
West-southwest.....	Kabil dau tir.	Kibu do suli kibu.		
West by south.....	Kabil dau choki.	Kibu ek suli kibu.	Anaut.	
West.....	Kabil.	Kibu.		
West by north.....	Kabil wijau choki.	Kibu ek agni kona.		
West-northwest.....	Kabil wijau tir.	Kibu do agni kona.		
Northwest by west.....	Gi dau arkrōp dau choki.	Kibu tin agni kona.		
Northwest.....	Gi dau arkrōp.	Agni kona.	Anaut Miauk.	
Northwest by north.....	Gi dau tir dau choki.	Uttā tin agni kona.		
North-northwest.....	Gi dau tir.	Uttā do agni kona.		
North by west.....	Gi dau choki.	Uttā ek agni kona.		



DETAILED

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P R E F A C E .

This publication contains the sailing directions for the Bay of Bengal and the coasts of India and Siam, from Calimere Point, Palk Strait, on the west to Salang Island on the east, including the Nicobar and Andaman Islands. It cancels all Notices to Mariners up to and including No. 28 of 1916.

The information contained in this publication is taken from all available sources and principally from British Admiralty publication "Bay of Bengal Pilot."

The bearings and courses are *true*, in degrees from 0° (north) to 360° (clockwise).

Bearings limiting the sectors of lights are toward the light.

The directions of the winds refer to the points from which they blow; of currents, the points toward which they set. These directions are *true*.

Variations for the year, with the annual rate of change, may be obtained from H. O. Chart No. 2406, Variation of the Compass.

Distances are expressed in nautical miles, the mile being approximately 2,000 yards.

Soundings are referred to low-water ordinary springs unless otherwise stated.

Heights are referred to mean high water, spring tides.

The latest information concerning lights, characteristics, sectors, and fogsignals should always be sought in H. O. publication No. 31, List of Lights, Volume II.

Attention is invited to the coupons on the first pages of this book, which entitle the purchaser to a summary of the Notices to Mariners affecting this publication. They will be ready for distribution as soon as practicable after the first of each year, beginning January, 1918.

In the interest of mariners, information regarding inaccuracies in this publication should be sent to the United States Hydrographic Office, Washington, D. C.

INFORMATION RELATING TO NAVIGATIONAL AIDS AND GENERAL NAVIGATION.

THE CORRECTION OF CHARTS, LIGHT LISTS, AND SAILING DIRECTIONS.

The following publications are issued by the United States Hydrographic Office as guides to navigation: Charts, Chart Catalogues, Sailing Directions, Light Lists, Tide Tables, Notices to Mariners, Pilot Charts, and Hydrographic Bulletins. Of these, the Notices to Mariners and the Hydrographic Bulletins are free to mariners and others interested in shipping. The Pilot Charts are free to contributors of professional information, but are sold to the general public at 10 cents a copy. The other publications of the office are sold under the law at cost price.

The Charts, the Sailing Directions, and the Light Lists are all affected by continual changes and alterations, concerning which information from all parts of the world is published weekly in the Notices to Mariners.

The charts are always corrected for all available information up to the date of issue stamped upon them; and the Light Lists should be noted for the recent alterations and additions. The Sailing Directions, however, can not, from their nature, be so fully corrected, and in all cases where they differ from the charts, the charts must be taken as the guide.

Charts.—When issued from the Hydrographic Office, the charts have received all necessary corrections to date.

All small but important corrections that can be made by hand are given in the Notices to Mariners, and should at once be placed on the charts to which they refer.

Extensive corrections that can not be conveniently thus made are put upon the plates, and new copies are put on sale. Masters of vessels are urged to replace the old charts, which should be destroyed to prevent the possibility of their being used in the navigation of the ship.

The dates on which extensive corrections are made are noted on the chart on the right of the middle of the lower edge; those of the smaller corrections at the left lower corners.

The edition, and corresponding date, of the chart will be found in the right lower corner, outside the outer neat line.

In all cases of quotations of charts, these dates of corrections should be given, as well as the number of the chart (found in the lower right and upper left corners), in order that the edition of the chart referred to may be known.

The Light Lists are corrected before issue, and all changes are published in the weekly Notices to Mariners.

The navigating officer should make notations in the tabular form in the Light Lists and paste in at the appropriate places slips from the Notices to Mariners.

The Light Lists should always be consulted as to the details of a light, as the description in the sailing directions is not complete, and may be obsolete, in consequence of changes since publication.

The Sailing Directions or Pilots are kept corrected by addenda; and subsequent to date of last addenda, they should be kept corrected by means of the Notices to Mariners. Sailing Directions issued to naval vessels carry with them an envelope containing slips of corrections up to date of issue.

Addenda are published from time to time, and contain a summary of all the information received up to date since the publication of the volume to which they refer, canceling all previous Notices to Mariners.

To enable the books to be more conveniently corrected, addenda and Notices to Mariners are printed on one side only, and two copies of the latter are issued to each naval vessel, one to be cut and the slips pasted in at the appropriate places, the other to be retained intact for reference.

To paste in the slips, as the Notices to Mariners are received, is one of the duties of the navigating officer, demanding faithful attention.

It must, however, be understood that Sailing Directions will rarely be correct in all details, and that, as already stated, when differences exist, the chart, which should be corrected from the most recent information, should be taken as the guide, for which purpose, for ordinary navigation, it is sufficient.

The Tide Tables, which are published annually by the United States Coast and Geodetic Survey, give the predicted times and heights of the high and the low waters for every day in the year at 70 of the principal ports of the world, and, through the medium of these by means of tidal differences and ratios, at a very large number of subordinate ports. The tables for the Atlantic and the Pacific coast ports of the United States are also published separately.

It should be remembered that these tables aim to give the times of high and low water, and not the times of turning of the current or of slack water, which may be quite different.

Notices to Mariners, containing fresh information pertaining to all parts of the world, are published weekly and mailed to all

United States ships in commission, Branch Hydrographic offices and agencies, and United States consulates. Copies are furnished free by the main office or by any of the branch offices on application.

With each Notice to naval vessels is sent also a separate sheet, giving the items relating to lights contained in the latest Notice, intended especially for use in correcting the Light Lists.

Pilot Charts of the North Atlantic, Central American Waters, and North Pacific and Indian Oceans are published each month, and of the South Atlantic and South Pacific Oceans each quarter. These charts give the average conditions of wind and weather, barometer, percentage of fog and gales, routes for steam and sailing vessels for the period of issue, ice and derelicts for the preceding period, ocean currents and magnetic variation for the current year, storm tracks for preceding years, and much other useful information. They are furnished free only in exchange for marine data or observations.

Hydrographic Bulletins, published weekly, are supplemental to the Pilot Charts, and contain the latest reports of obstructions and dangers along the coast and principal ocean routes, ice, derelicts, and wreckage, reports of the use of oil to calm the sea, and other information for mariners. They are to be had free upon application.

THE USE OF CHARTS.

Accuracy of chart.—The value of a chart must manifestly depend upon the character and accuracy of the survey on which it is based, and the larger the scale of the chart the more important do these become.

To judge of a survey, its source and date, which are generally given in the title, are a good guide. Besides the changes that may have taken place since the date of the survey, in waters where sand or mud prevails, the earlier surveys were mostly made under circumstances that precluded great accuracy of detail; until a chart founded on such a survey is tested, it should be regarded with caution. It may, indeed, be said that, except in well-frequented harbors and their approaches, no surveys yet made have been so thorough as to make it certain that all dangers have been found. The number of the soundings is another method of estimating the completeness of the survey, remembering, however, that the chart is not expected to show all the soundings that were obtained. When the soundings are sparse or unevenly distributed, it may be taken for granted that the survey was not in great detail.

Large or irregular blank spaces among soundings mean that no soundings were obtained in these spots. When the surrounding soundings are deep it may fairly be assumed that in the blanks the water is also deep; but when they are shallow, or it can be

seen from the rest of the chart that reefs or banks are present, such blanks should be regarded with suspicion. This is especially the case in coral regions and off rocky coasts, and it should be remembered that in waters where rocks abound it is always possible that a survey, however complete and detailed, may have failed to find every small patch or pinnacle rock.

A wide berth should therefore be given to every rocky shore or patch, and instead of considering a coast to be clear, the contrary should be assumed.

Fathom curves a caution.—Except in charts of harbors that have been surveyed in detail, the 5-fathom curve on most charts may be considered as a danger line or caution against unnecessarily approaching the shore or bank within that line, on account of the possible existence of undiscovered inequalities of the bottom, which only an elaborate detailed survey could reveal. In general surveys of coasts or of little frequented anchorages, the necessities of navigation do not demand the great expenditure of time required for so detailed a survey. It is not contemplated that ships will approach the shores in such localities without taking special precautions.

The 10-fathom curve on rocky shores is another warning, especially for ships of heavy draft.

A useful danger curve will be obtained by tracing out with a colored pencil, or ink, the line of depth next greater than the draft of the ship using the chart. For vessels drawing less than 18 feet the edge of the sanding serves as a well-marked danger line.

Charts on which no fathom curves are marked must especially be regarded with caution, as indicating that soundings were too scanty and the bottom too uneven to enable the curves to be drawn with accuracy.

Isolated soundings, shoaler than surrounding depths, should always be avoided, especially if ringed around, as it is doubtful how closely the spot may have been examined and whether the least depth has been found.

The chart on largest scale should always be used on account of its greater detail and the greater accuracy with which positions may be plotted on it.

Caution in using small-scale charts.—In approaching the land or dangerous banks, regard must always be had to the scale of the chart used. A small error in laying down a position means only yards on a large-scale chart, whereas on one of small scale the same amount of displacement means a large fraction of a mile.

Distortion of printed charts.—The paper on which charts are printed from engraved plates has to be damped. On drying distortion takes place from the inequalities of the paper, which greatly

varies with different papers and the amount of the damping; but it does not affect navigation. The larger the chart the greater the amount of this distortion. It must not, however, be expected that accurate series of angles taken to different points will always exactly agree when carefully plotted on the chart, especially if the lines to objects be long.

Mercator chart.—Observed bearings are not identical with those measured on the Mercator chart (excepting only the bearings north and south, and east and west on the equator) because the line of sight, except as affected by refraction, is a straight line and lies in the plane of the great circle, while the straight line on the chart (except the meridian line) represents, not the arc of a great circle, but the loxodromic curve, or rhumb line, which on the globe is a spiral approaching but never in theory reaching the pole, or, if the direction be east and west, a circle of latitude.

The difference is not appreciable with near objects, and in ordinary navigation may be neglected. But in high latitudes, when the objects are very distant and especially when lying near east or west, the bearings must be corrected for the convergence of the meridians in order to be accurately placed on the Mercator chart, which represents the meridians as parallel.

On the polyconic chart, since a straight line represents (within the limits of 15 or 20 degrees of longitude) the arc of a great circle or the shortest distance between two points, bearings of the chart are identical with observed bearings.

The mercator projection is unsuited to surveying, for which purpose the polyconic projection is used by the Hydrographic Office and the Coast and Geodetic Survey.

Notes on charts should always be read with care, as they may give important information that can not be graphically represented.

Buoys.—Too much reliance should not be placed on buoys always maintaining their exact positions. They should therefore be regarded as warnings, and not as infallible navigational marks, especially when in exposed places and in the wintertime; and a ship's position should always, when possible, be checked by bearings or angles of fixed objects on shore.

Gas buoys.—The lights shown by gas buoys can not be implicitly relied on; the light may be altogether extinguished, or, if periodic, the apparatus may get out of order.

Whistle and bell buoys are sounded only by the action of the sea; therefore, in calm weather, they are less effective or may not sound.

Lights.—All the distances given in the Light Lists and on the charts for the visibility of lights are calculated for a height of 15 feet for the observer's eye. The effect of a greater or less height

of eye can be ascertained by means of the table of distances of visibility due to height, published in the Light Lists.

The glare of a powerful light is often seen far beyond the limit of visibility of the actual rays of the light, but this must not be confounded with the true range. Refraction, too, may often cause a light to be seen farther than under ordinary circumstances.

When looking out for a light, the fact may be forgotten that aloft the range of vision is much increased. By noting a star immediately over the light a very correct bearing may be obtained from the standard compass when you lay down from aloft.

On first making a light from the bridge, by at once lowering the eye several feet and noting whether the light is made to dip, it may be determined whether the ship is on the circle of visibility corresponding with the usual height of the eye, or unexpectedly nearer the light.

The intrinsic power of a light should always be considered when expecting to make it in thick weather. A weak light is easily obscured by haze, and no dependence can be placed on its being seen.

The power of a light can be estimated by its candlepower or order, as stated in the Light Lists, and in some cases by noting how much its visibility in clear weather falls short of the range corresponding to its height. Thus, a light standing 200 feet above the sea and recorded as visible only 10 miles in clear weather, is manifestly of little brilliancy, as its height would permit it to be seen over 20 miles if of sufficient power.

Fog signals.—Sound is conveyed in a very capricious way through the atmosphere. Apart from the influence of the wind large areas of silence have been found in different directions and at different distances from the origin of sound, even in clear weather; therefore, too much confidence should not be felt as to hearing a fog signal. The apparatus, moreover, for sounding the signal often requires some time before it is in readiness to act. A fog often creeps imperceptibly toward the land, and may not be observed by the lighthouse keepers until upon them; a ship may have been for many hours in it, and approaching the land in confidence, depending on the signal, which is not sounded. When sound travels against the wind, it may be thrown upward; a man aloft might then hear it though inaudible on deck.

The submarine bell system of fog signals is much more reliable than systems transmitting sound through the air, as sound traveling in water is not subject to the same disturbing influences; the fallibility of the lighthouse keeper is, however, about the same in all systems, so that caution should be observed even by vessels equipped with submarine-bell receiving apparatus.

Submarine bells have an effective range of audibility greater than signals sounded in air, and a vessel equipped with receiving apparatus may determine the approximate bearing of the signal. These signals may be heard also on vessels not equipped with receiving apparatus by observers below the water line, but the bearing of the signal can not then be readily determined.

Vessels equipped with radio apparatus and submarine bell receivers may fix their distance from a light vessel having radio and submarine bell, utilizing the difference in velocity of sound waves of the radio and the bell. Sound travels 4,794 feet per second at 66° F. in water, and the travel of radio sound waves for practicable distances may be taken as instantaneous.

All vessels should observe the utmost caution in closing the land in fogs. The lead is the safest guide and should be faithfully used.

Tides.—A knowledge of the times of high and low water and of the amount of vertical rise and fall of the tide is of great importance in the case of vessels entering or leaving port, especially when the low water is less than or near their draft. Such knowledge is also useful at times to vessels running close along a coast, in enabling them to anticipate the effect of the tidal currents in setting them on or offshore. This is especially important in fog or thick weather.

The predicted times and heights of the high and low waters, or differences by which they may be readily obtained, are given in the Tide Tables for all the important ports of the world. The height at any intermediate time may be obtained by means of Tables 2A and 2B for most of the principal tidal stations of the United States, given in Table 1, and for the subordinate stations of Table 3 by using them as directed in the Tide Tables. The intermediate height may also be obtained by plotting the predicted times and heights of high and low water and connecting the points by a curve. Such knowledge is often useful in crossing a bar or shallow flats.

Planes of reference.¹—The plane of reference for soundings on Hydrographic Office charts made from United States Government surveys and on Coast and Geodetic Survey charts of the Atlantic coast of the United States is mean low water; on the Pacific coast of the United States as far as the Strait of Juan Fuca, it is the mean of the lower low waters; and from Puget Sound to Alaska, the plane employed on Hydrographic Office charts is low water ordinary springs.

On most of the British Admiralty charts the plane of reference is the low water of ordinary springs; on French charts, the low water of equinoctial springs.

¹ The distinction between "rise" and "range" of the tide should be understood. The former expression refers to the height attained above the datum plane for soundings, differing with the different planes of reference; the latter, to the difference of level between successive high and low waters.

In the case of many charts compiled from old or various sources the plane of reference may be in doubt. In such cases, or when ever not stated on the chart, the assumption that the reference plane is low water ordinary springs gives a larger margin of safety than mean low water.

Whichever plane of reference may be used for a chart it must be remembered that there are times when the tide falls below it. Low water is lower than mean low water about half the time, and when a new or full moon occurs at perigee the low water is lower than the average low water of springs. At the equinoxes the spring range is also increased on the coasts of Europe, but in some other parts of the world, and especially in the Tropics, such periodic low tides may coincide more frequently with the solstices.

Wind or a high barometer may at times cause the water to fall below even a very low plane of reference.

On coasts where there is much diurnal inequality in the tides, the amount of rise and fall can not be depended upon and additional caution is necessary.

Mean sea level.—The important fact should be remembered that the depths at half tide are practically the same for all tides, whether neaps or springs. Half tide therefore corresponds with mean sea level. This makes a very exact plane of reference, easily found, to which it would be well to refer all high and low waters.

The Tide Tables give in Table 3, for all the ports, the plane of reference to which tidal heights are referred and its distance below mean sea level.

If called on to take special soundings for the chart at a place where there is no tidal bench mark, mean sea level should be found and the plane for reductions established at the proper distance below it, as ascertained by the Tide Tables, or by observations, or in some cases, if the time be short, by estimation, the data used being made a part of the record.

Tidal streams.—In navigating coasts where the tidal range is considerable, especial caution is necessary. It should be remembered that there are indrafts to all bays and bights, although the general run of the stream may be parallel with the shore.

The turn of the tidal stream offshore is seldom coincident with the times of high and low water on the shore. In some channels the tidal stream may overrun the turn of the vertical movement of the tide by three hours, forming what is usually known as tide and half tide, the effect of which is that at high and low water by the shore the stream is running at its greatest velocity

The effect of the tidal wave in causing currents may be illustrated by two simple cases.

(1) Where there is a small tidal basin connected with the sea by a large opening.

(2) Where there is a large tidal basin connected with the sea by a small opening.

In the first case the velocity of the current in the opening will have its maximum value when the height of the tide within is changing most rapidly, i. e., at a time about midway between high and low water. The water in the basin keeps at approximately the same level as the water outside. The flood stream corresponds with the rising and the ebb with the falling of the tide.

In the second case the velocity of the current in the opening will have its maximum value when it is high water or low water without, for then there is the greatest head of water for producing motion. The flood stream begins about three hours after low water, and the ebb stream about three hours after high water, slack water thus occurring about midway between the tides.

Along most shores not much affected by bays, tidal rivers, etc., the current usually turns soon after high water and low water.

The swiftest current in straight portions of tidal rivers is usually in the middle of the stream, but in curved portions the most rapid current is toward the outer edge of the curve, and here the water will be deepest. The pilot rule for best water is to follow the ebb tide reaches.

Countercurrents and eddies may occur near the shores of straits, especially in bights and near points. A knowledge of them is useful in order that they may be taken advantage of or avoided.

A swift current often occurs in a narrow passage connecting two large bodies of water, owing to their considerable difference of level at the same instant. The several passages between Vineyard Sound and Buzzards Bay are cases in point. In the Woods Hole passage the maximum strength of the tidal streams is at about half tide.

Tide rips are made by a rapid current setting over an irregular bottom, as at the edges of banks where the change of depth is considerable.

Current arrows on charts show only the most usual or the mean direction of a tidal stream or current; it must not be assumed that the direction of a stream will not vary from that indicated by the arrow. The rate, also, of a stream constantly varies with circumstances, and the rate given on the chart is merely the mean of those found during the survey, possibly from very few observations.

FIXING POSITION.

Sextant method.—The most accurate method available to the navigator of fixing a position relative to the shore is by plotting with a protractor, sextant angles between three well-defined objects on

shore which are shown on the chart; this method, based on the "three-point problem" of geometry, should be in general use.

For its successful employment it is necessary: First, that the objects be well chosen; and, second, that the observer be skillful and rapid in his use of the sextant. The latter is only a matter of practice. Two observers are better for this method.

Near objects should be used either for bearings or angles for position in preference to distant ones, although the latter may be more prominent, as a small error in the bearing or angle or in laying it on the chart has a greater effect in misplacing the position the longer the line to be drawn.

On the other hand distant objects should be used for direction, because less affected by a small error or change of position.

The three-arm protractor or station pointer consists of a graduated brass circle with one fixed and two movable radial arms, the three beveled edges of the arms, if produced, intersecting at the exact center of the instrument. The edge of the fixed arm marks the zero of the graduation which enables the movable arms to be set at any angles with the fixed arm.

To plot a position, the two angles observed between the three selected objects are set on the instrument, which is then moved over the chart until the three beveled edges pass respectively and simultaneously through the three objects. The center of the instrument will then mark the ship's position, which may be pricked on the chart or marked with a pencil point through the center hole.

The transparent xylonite protractor is an excellent substitute for the brass instrument and in some cases preferable to it, as when, for instance, the objects angled on are so near the observer that they are more or less hidden by the circle of the instrument. The xylonite protractor also permits the laying down for simultaneous trial of a number of angles in cases of fixing important positions. Plain tracing paper may also be used if there are any suitable means of laying off the angles.

The value of a determination depends greatly on the relative positions of the objects observed. If the position sought lies on the circle passing through three objects (in which case the sum of the observed angles equals the supplement of the angle at the middle object made by lines from the other two) it will be indeterminate, as it will plot all around the circle. Such an observation is called a "revolver." An approach to this condition must be avoided. Near objects are better than distant ones, and, in general, up to 90° the larger the angles the better, remembering always that large as well as small angles may plot on or near the circle and hence be worthless. If the objects are well situated, even very small angles will give for

navigating purposes a fair position, when that obtained by bearings of the same objects would be of little value.

Accuracy requires that the two angles be simultaneous. If under way and there is but one observer the angle that changes less rapidly may be observed both before and after the other angle and the proper value obtained by interpolation.

A single angle and a range of two objects give in general an excellent fix, easily obtained and plotted.

Advantages of sextant method.—In many narrow waters where the objects may yet be at some distance, as in coral harbors or narrow passages among mud banks, navigation by sextant and protractor is invaluable, as a true position can in general be obtained only by its means. Positions by bearings are too rough to depend upon, and a small error in either taking or plotting a bearing might under such circumstances put the ship ashore.

In all cases where great accuracy of position is desired, such as the fixing of a rock or shoal, or of fresh soundings or new buildings as additions to the chart, the sextant should invariably be used. In all such cases angles should be taken to several objects, the more the better; but five objects is a good number, as the four angles thus obtained not only prevent any errors, but they at once furnish a means of checking the accuracy of the chart itself. If a round of angles can be taken the observer's accuracy is also checked. In the case of ordinary soundings a third angle need be taken only occasionally; first, to check the general accuracy of the chart, as above stated; second, to make certain that the more important soundings, as at the end of a line, are correctly placed.

If communication can be had with the shore, positions may be fixed with great accuracy by occupying with theodolite or sextant two known points of the chart. The third angle of the triangle, that between the two points at the position sought, should be measured as a check.

The compass.—It is not intended that the use of the compass to fix the ship should be given up; in ordinary piloting the compass, with its companion, the pelorus, may be usefully employed for this purpose, although less accurate than the sextant.

If the accuracy of the chart is doubtful, the compass should be used in preference to the sextant.

In fixing by the compass, it should always be remembered that a position by two bearings only, like that by two angles only, is liable to error. An error may be made in taking a bearing, or in applying to it the deviation, or in laying it on the chart. A third or check bearing should, therefore, be taken of some other object, especially when near the shore or dangers. A common intersection for the three lines assures accuracy.

When the three lines do not intersect in a point, the following rule holds: If the line drawn to the middle object falls to the right of the point of intersection of the lines to the two outside objects, the position of the observer was to the right of the line to the middle object; and if it falls to the left of the intersection his position was to the left of the line. Thus it will be seen that the assumption, that the position is at the center of the triangle formed by the intersecting lines, is incorrect.

Doubling the angle on the bow.—The method of fixing by doubling the angle on the bow is invaluable. The ordinary form of it, the so-called "bow and beam bearing," the distance from the object at the latter position being the distance run between the times of taking the two bearings, gives the maximum of accuracy, and is an excellent fix for a departure, but does not insure safety, as the object observed and any dangers off it are abeam before the position is obtained.

By taking the bearings at two points and four points on the bow, a fair position is obtained before the object is passed, the distance of the latter at the second position being, as before, equal to the distance run in the interval, allowing for current. Taking afterwards the beam bearing gives, with slight additional trouble, the distance of the object when abeam; such beam bearings and distances, with the times, should be continuously recorded as fresh departures, the importance of which will be appreciated in cases of being suddenly shut in by fog.

When the first bearing is $26\frac{1}{2}^{\circ}$ from ahead, and the second 45° , the run between bearings will equal the distance at which the object will be passed abeam.

A table of multipliers of the distance run in the interval between any two bearings of an object, the product being its distance at the time of the second bearing, is given in the Light Lists and in Bowditch.

Danger angle.—The utility of the danger angle in passing outlying rocks or dangers should not be forgotten. In employing the horizontal danger angle, however, caution is necessary, as should the chart be inaccurate, i. e., should the objects selected be not quite correctly placed, the angle taken off from it may not serve the purpose. It should not, therefore, be employed when the survey is old or manifestly imperfect.

The vertical danger angle may be conveniently used when passing elevated points of known heights, such as lighthouses, cliffs, etc. The computation of the distance corresponding to the height of the object and its angular elevation requires for small distances merely the solution of a plain right triangle; the natural cotangent of the angle multiplied by the height in feet gives the distance in

feet. The convenient use of this method, however, requires tables such as those published by Capt. Lecky in his little book entitled "The Danger Angle and Offshore Distance Tables." This book very usefully extends the vertical angle method to finding a ship's position at sea by observing the angular altitude of a peak of known height and its bearing. The tables give heights up to 18,000 feet and distances up to 110 miles.

When the angles are not too large they should be observed "on and off the limb" and the index error of the sextant thus eliminated, in preference to correcting for it the single altitude. It must be remembered that in high latitudes the bearing of a distant object needs correction for the convergence of the meridians before being laid down on a Mercator chart. The correction may be found by the following formula, using the approximate position: The sine of the correction equals the product of the sine of half the difference of longitude by the sine of the middle latitude. It is applied on the equatorial side of the observed bearing and its effect is always to increase the latitude of the observer.

Soundings taken at random are of little value in fixing or checking position and may at times be misleading. In thick weather, when near or closing the land, soundings should be taken continuously and at regular intervals, and, with the character of the bottom, systematically recorded. By laying the soundings on tracing paper, according to the scale of the chart, along a line representing the track of the ship, and then moving the paper over the chart, keeping the line representing the track parallel with the course until the observed soundings agree with those of the chart, the ship's position will in general be quite well determined. This plan was suggested by Lord Kelvin, whose admirable sounding machine renders the operation of sounding possible in quite deep water, without slowing down the ship and consequent loss of time.

Pelorus.—All ships should be supplied with the means of taking accurate bearings both by night and by day. The standard compass is not always conveniently placed for the purpose; in such case a pelorus will be very useful, but the results are not as accurate as those obtained direct from the compass. The utility of such an instrument in ascertaining the change of bearing of an approaching ship should not be overlooked.

Position lines.—Among the various methods of fixing position at sea, the one which should be best understood and put to the most constant use is that employing position or Sumner lines. These lines give the most comprehensive information to the navigator with the least expenditure of labor and time. The knowledge gained is that the vessel must be somewhere on the line, provided the data used are accurate and the chronometer correct. As the information

given by one line of position is not sufficient to determine the definite location of the vessel, it is necessary to cross this line by another similarly obtained, and the vessel being somewhere on both must be at their intersection. However, a single line, at times, will furnish the mariner with invaluable information; for instance, if it is directed toward the coast, it marks the bearing of a definite point on the shore, or if parallel to the coast it clearly indicates the distance off, and so will often be found useful as a course. A sounding taken at the same time with the observation will in certain conditions prove of great value in giving an approximate position on the line.

The easiest and quickest way to establish a line of position is by employing the method of Marcq St. Hilaire, as modified by the use of tables of altitude. The principle of this method is one of altitude differences, in which the observed altitude is compared with the computed altitude for a dead reckoning, or other selected position, and the difference in minutes of latitude measured toward the body along the line of its azimuth, if the observed altitude is greater than the computed altitude, and vice versa. A line drawn at right angles to the line of azimuth through the point thus determined is the position line, somewhere upon which will be found the position of the vessel. The tables of altitude obviate the computation of the altitude and thereby greatly facilitate the establishment of the line.

A position line may also be found by computing two positions for longitude with two assumed latitudes, and drawing the line between them; or by drawing to the position obtained with one latitude a line at right angles to the bearing of the body as taken from the azimuth tables.

A very accurate position can be obtained by observing two or more stars at morning or evening twilight, at which time the horizon is well defined. The position lines thus obtained will, if the bearings of the stars differ three points or more, give an excellent result. A star or planet at twilight and the sun afterwards or before may be combined; also two observations of the sun with sufficient interval to admit of a considerable change of bearing. In these cases one of the lines must be moved for the run of the ship. The moon is often visible during the day and in combination with the sun gives an excellent fix.

The morning and evening twilight observations, besides their great accuracy, possess the additional advantage of greatly extending the ship's reliable reckoning beyond the limits of the ordinary day navigation, and correspondingly restricting the dead reckoning uncertainties of the night. An early morning fix in particular is often of great value. Though the same degree of

accuracy as at twilight can not be expected, night observations are very valuable and should be assiduously practiced.

Piloting.—The navigator, in making his plan for entering a strange port, should give very careful previous study to the chart and sailing directions, and should select what appear to be the most suitable marks for use, also providing himself with substitutes to use in case those selected as most suitable should prove unreliable in not being recognized with absolute certainty. Channel buoys seen from a distance are difficult to identify, because their color is sometimes not easily distinguished and they may appear equally distant from the observer even though they be at widely varying distances. Ranges should be noted, if possible, and the lines drawn, both for leading through the best water in channels, and also for guarding against particular dangers; for the latter purpose safety bearings should in all cases be laid down where no suitable ranges appear to offer. The courses to be steered in entering should also be laid down and distances marked thereon. If intending to use the sextant and danger angle in passing dangers, and especially in passing between dangers, the danger circles should be plotted and regular courses planned, rather than to run haphazard by the indications of the angle alone, with the possible trouble from bad steering at critical points.

The ship's position should not be allowed to be in doubt at any time, even in entering ports considered safe and easy of access, and should be constantly checked, continuing to use for this purpose those marks concerning which there can be no doubt until others are unmistakably identified.

The ship should ordinarily steer exact courses and follow an exact line, as planned from the chart, changing course at precise points, and, where the distances are considerable, her position on the line should be checked at frequent intervals. This is desirable even where it may seem unnecessary for safety, because if running by the eye alone and the ship's exact position be immediately required, as in a sudden fog or squall, fixing at that particular moment may be attended with difficulty.

The habit of running exact courses with precise changes of course will be found most useful when it is desired to enter port or pass through inclosed waters during fog by means of the buoys; here safety demands that the buoys be made successively, to do which requires, if the fog be dense, very accurate courses and careful attention to the times, the speed of the ship, and the set of the current; failure to make a buoy as expected leaves, as a rule, no safe alternative but to anchor at once, with perhaps a consequent serious loss of time.

In passing between dangers where there are no suitable leading marks, as, for instance, between two islands or an island and the main shore, with dangers extending from both, a mid-channel course may be steered by the eye alone with great accuracy, as the eye is able to estimate very closely the direction midway between visible objects.

In piloting among coral reefs or banks, a time should be chosen when the sun will be astern, conning the vessel from aloft or from an elevated position forward. The line of demarcation between the deep water and the edges of the shoals, which generally show as green patches, is indicated with surprising clearness. This method is of frequent application in the numerous passages of the Florida Keys.

Changes of course should in general be made by exact amounts, naming the new course or the amount of the change desired, rather than by ordering the helm to be put over and then steadying when on the desired heading, with the possibility of the attention being diverted and so of forgetting in the meantime, as may happen, that the ship is still swinging. The helmsman, knowing just what is desired and the amount of the change to be made, is thus enabled to act more intelligently and to avoid bad steering, which in narrow channels is a very positive source of danger.

Coast piloting involves the same principles and requires that the ship's position be continuously determined or checked as the landmarks are passed. On well-surveyed coasts there is a great advantage in keeping near the land, thus holding on to the marks and the soundings, and thereby knowing at all times the position, rather than keeping offshore and losing the marks, with the necessity of again making the land from vague positions, and perhaps the added inconvenience of fog or bad weather, involving a serious loss of time and fuel.

The route should be planned for normal conditions of weather, with suitable variations where necessary in case of fog or bad weather or making points at night, the courses and distances, in case of regular runs over the same route, being entered in a notebook for ready reference, as well as laid down on the chart. The danger circles for either the horizontal or the vertical danger angles should be plotted, wherever the method can be usefully employed, and the angles marked thereon; many a mile may thus be saved in rounding dangerous points with no sacrifice in safety. Ranges should also be marked in, where useful for position or for safety, and also to use in checking the deviation of the compass by comparing, in crossing, the compass bearing of the range with its magnetic bearing, as given by the chart.

Changes of course will in general be made with mark or object abeam, the position (a new "departure") being then, as a rule, best and most easily obtained. The pelorus should be at all times in readiness for use, and the chart where it may be readily consulted by the officer of the watch. The sextant should also be kept conveniently at hand.

A continuous record of the progress of the ship should be kept by the officer of the watch, the time and patent-log reading of all changes of course and of all bearings, especially the two and four point bearings, with distance of object when abeam, being noted in a book kept in the pilot house for this especial purpose. The ship's reckoning is thus continuously cared for as a matter of routine and without the presence or particular order of the captain or navigating officer. The value of thus keeping the reckoning always fresh and exact will be especially appreciated in cases of sudden fog or when making points at night.

Where the coastwise trip must be made against a strong head wind, it is desirable, with trustworthy charts, to skirt the shore as closely as possible in order to avoid the heavier seas and adverse current that prevail farther out. In some cases, with small ships, a passage can be made only in this way. The important saving of coal and of time, which is even more precious, thus effected by skillful coast piloting makes this subject one of prime importance to the navigator.

Change in the variation of the compass.¹—The gradual change in the variation must not be forgotten in laying down on the chart courses and bearings. The magnetic compasses placed on the charts for the purpose of facilitating the plotting become in time slightly in error, and in some cases, such as with small scales or when the lines are long, the displacement of position from neglect of this change may be of importance. The date of the variation and the annual change, as given on the compass rose, facilitate corrections when the change has been considerable. The compasses are reengraved once in ten years; more frequent alterations on one spot in a copperplate would not be practicable.

The change in the variation is in some parts of the world so rapid as to need careful consideration, requiring a frequent change of the course. For instance, in approaching Halifax from Newfoundland the variation changes 10° in less than 500 miles.

Local magnetic disturbance of the compass on board ship.—The term "local magnetic disturbance" has reference only to the effects on the compass of magnetic masses external to the

¹ See H. O. Chart No. 2436, Variation of the Compass.

ship. Observation shows that disturbance of the compass in a ship afloat is experienced in only a few places on the globe.

Magnetic laws do not permit of the supposition that the visible land causes such disturbance, because the effect of a magnetic force diminishes so rapidly with distance that it would require a local center of magnetic force of an amount absolutely unknown to affect a compass half a mile distant.

Such deflections of the compass are due to magnetic minerals in the bed of the sea under the ship, and when the water is shallow and the force strong, the compass may be temporarily deflected when passing over such a spot; but the area of disturbance will be small unless there are many centers near together.

Use of oil for modifying the effect of breaking waves.—Many experiences of late years have shown that the utility of oil for this purpose is undoubted, and the application simple.

The following may serve for the guidance of seamen, whose attention is called to the fact that a very small quantity of oil, skillfully applied, may prevent much damage both to ships, especially of the smaller classes, and to boats by modifying the action of breaking seas.

The principal facts as to the use of oil are as follows:

1. On free waves, i. e., waves in deep water, the effect is greatest.
2. In a surf, or waves breaking on a bar, where a mass of liquid is in actual motion in shallow water, the effect of the oil is uncertain, as nothing can prevent the larger waves from breaking under such circumstances; but even here it is of some service.
3. The heaviest and thickest oils are most effectual. Refined kerosene is of little use; crude petroleum is serviceable when no other oil is obtainable, or it may be mixed with other oils; all animal and vegetable oils, such as waste oil from the engines, have great effect.
4. In cold water, the oil, being thickened by the low temperature and not being able to spread freely, will have its effect much reduced, a rapid-spreading oil should be used.
5. A small quantity of oil suffices, if applied in such a manner as to spread to windward.
6. It is useful in a ship or boat either when running, or lying-to, or in wearing.
7. When lowering and hoisting boats in a heavy sea the use of oil has been found greatly to facilitate the operation.
8. For a ship at sea the best method of application appears to be to hang over the side, in such a manner as to be in the water, small canvas bags, capable of holding from 1 to 2 gallons of oil, the bags being pricked with a sail needle to permit leakage. The waste pipes forward are also very useful for this purpose.

9. Crossing a bar with a flood tide, to pour oil overboard and allow it to float in ahead of the boat, which would follow with a bag towing astern, would appear to be the best plan.

On a bar, with the ebb tide running, it would seem to be useless to try oil for the purpose of entering.

10. For boarding a wreck, it is recommended to pour oil overboard to windward of her before going alongside, bearing in mind that her natural tendency is always to forge ahead. If she is aground the effect of oil will depend upon attending circumstances.

11. For a boat riding in bad weather to a sea anchor, it is recommended to fasten the bag to an endless line rove through a block on the sea anchor, by which means the oil can be diffused well ahead of the boat, and the bag readily hauled on board for refilling, if necessary.

CHAPTER I.

GENERAL REMARKS ON THE BAY OF BENGAL; INDIA; MADRAS PRESIDENCY AND DISTRICTS; BENGAL PROVINCE AND DISTRICTS; BURMA AND ITS DISTRICTS; NICOBAR AND ANDAMAN ISLANDS; WINDS AND WEATHER; CYCLONES; BAROMETER; STORM AND WEATHER SIGNALS; CURRENTS; TIDES; TEMPERATURE OF SEA; SOUNDINGS; COAL; DOCKS; REPAIRS; TIME SIGNALS; RADIO STATIONS; UNIFORM SYSTEM OF BUOYAGE; MAGNETIC VARIATION; PASSAGES—FULL-POWERED STEAMERS; SAILING VESSELS; LOW-POWER STEAM VESSELS.

The Bay of Bengal is a considerable gulf of the Indian Ocean, triangular in shape, and comprised between the parallels of 8° and 20° north latitude, and the meridians of 80° and 98° east longitude. It is bordered on the west by the coasts of Ceylon and of India, and on the east by the coasts of Burma and the Malay Peninsula. The distance between Chittagong on the east, and Balasore on the west, at its head, is about 175 miles, and the distance across its mouth, from the Malay Peninsula to Cape Comorin, is about 1,200 miles; or, between the southern point of Ceylon and the northern point of Sumatra, about 880 miles.

India, which, together with Ceylon, forms the western boundary of the Bay of Bengal, is a great irregular triangular-shaped peninsula stretching southward from Asia into the sea. Its northern boundary is the Himalayan Mountain ranges; the chief part of its western side is washed by the Arabian Sea, and the most of its eastern side by the Bay of Bengal.

It extends from latitude 8° north to latitude 35° north, and its greatest length north and south, as well as its greatest breadth east and west, is about 1,900 miles; it tapers with a pear-shaped curve to a point at Cape Comorin, its southern extremity; whilst Burma, the strip of country extending southward to the eastward of the Indian Peninsula, forms the eastern shore of the Bay of Bengal. The whole territory thus described contains 1,767,000 square miles, and 294,000,000 inhabitants.

Ceylon, a large island, is separated from the southeastern end of the peninsula of India by the Gulf of Manar and Palk Strait.

Of the territories which border the Bay of Bengal the whole are under British rule with the exception of that southward of Pakchan

River, in the Malay Peninsula, which is part of the Kingdom of Siam; and the small French colonies of Pondicherri, Karikal, and Yanam or Yanaon, on the western shore of the bay, and Chandernagore, on the Hugli above Calcutta.

Madras Presidency—General remarks.—Madras, officially styled the Presidency of Fort St. George, occupies, with its dependencies and with the State of Mysore, the entire south of the peninsula of India with the exception of the small French settlements of Pondicherri, Karikal, and Yanam or Yanaon. The area of British districts is 142,330 square miles, the native States occupying an additional area of 70,000 square miles.

It has a coast line of 1,730 miles, but that included in this work on the west side of the Bay of Bengal only extends from Calimere Point as far northward as the southern end of Chilka Lake, and that part of it from Calimere Point to about the parallel of 17° north is known as the Coromandel Coast.

The governor of Madras is assisted by a council, ordinarily of 2 members, to whom are added others, not exceeding 21 in number. Madras City is the capital.

Mountains.—The Western Ghats which extend the whole length of the western coast, at distances of from 50 to 100 miles from the sea, are from 4,000 to 8,000 feet high, and the Eastern Ghats, a less marked formation, about 2,000 feet high, back the eastern coast; between these latter and the Bay of Bengal is a broad strip of land.

Rivers.—Nearly the whole trend of the drainage is from west to east into the Bay of Bengal, the three principal rivers being the Godavari, the Kistna, and the Cauvery, all three rising on the western side of the peninsula, and forcing passages for themselves through the Eastern Ghats; the Godavari and the Kistna have each a course of more than 800 miles. The rivers will be described under the headings of the districts, as also will the geology, flora, fauna, etc.

Population.—The population in British territory in 1911 was 41,405,404, of which rather more than 1,000,000 were Christians, about 62 per cent of these latter being Roman Catholics. An extraordinary number of languages are spoken, but the principal are Tamil, Telugu, Malayalam, Kanarese, Oriya, and Hindustani.

Products.—Cotton, oilseeds, rice, and indigo are grown, and in addition to that from sugar canes sugar is obtained in large quantities from palms; tobacco, tea, cinchona, and various spices are also produced. Of industries, there are cotton and silk spinning and weaving mills, ivory and metal work, and cigar making. The soil is not naturally fertile, but it has been greatly improved by irrigation systems in the river deltas.

Minerals.—The minerals which occur have so far not been profitable. Gold is washed in some rivers; iron is melted in a primitive manner by the natives; coal of an inferior quality exists near the

upper reaches of the Godavari River; graphite is mined, and there are large deposits of magnesite, a rare mineral.

Ports.—Although there is a coast line of over 1,700 miles, there is no good natural harbor; the artificial harbor at Madras was constructed at considerable expense. Cocanada gives partial shelter, and a proposed harbor at Vizagapatam by dredging the river and back-water would enable large vessels to go alongside docks.

Time.—Indian standard time, corresponding to the meridian of $82^{\circ} 30' 0''$ east of Greenwich, or 5h. 30m. 0s. in advance of Greenwich Mean Time, is kept.

Districts.—The description of the west coast of the Bay of Bengal begins at Calimere Point in Tanjore District, from which are the following districts on the coast in the order given: Tanjore, South Arcot, Chengalpat (Chingleput), Nellore, Guntur, Kistna, Godavari, Vizagapatam, and Ganjam; in addition to these are the small French territories of Karikal, Pondicherri, and Yanam or Yanaon.

Tanjore, a district lying northward of Madura District, between latitude $9^{\circ} 49'$ north and latitude $11^{\circ} 25'$ north, and longitude $78^{\circ} 47'$ east and longitude $79^{\circ} 52'$ east, has an area of 3,710 square miles. It is bounded on the southwest by Madura District and on the north by Coleroon River, which separates it from Trichinopoli and South Arcot Districts. Its seaboard consists of two sections, one bordering Palk Strait for 68 miles, from the Madura boundary to Calimere Point; the other from Calimere Point to Coleroon River, a distance of 72 miles; the small French territory of Karikal is situated about the middle of the latter section.

About the middle of the tenth century the district formed part of the Chola Kingdom, but passed from them in the thirteenth century, and in the fourteenth became part of the Hindu Kingdom of Vijayanagar. The British first came into contact with Tanjore by their expedition in 1749, with a view to the restoration of a deposed Raja. In 1799 the Raja Sarabhoji resigned the district into the hands of the British, but still exercised certain sovereign authority, and, in 1855, his son dying without heirs, the whole became British territory.

Physical features.—The northern and eastern portions of Tanjore form the delta of the Cauvery River, which, with its numerous branches, intersects and irrigates more than half the district, and this is the most densely populated area. It is a level alluvial plain, covered almost without a break by rice fields and sloping gently toward the sea, with the villages half hidden by cocoanut palms, and is devoid of forests, with no eminences except ridges and dunes of blown sand, which fringe the coast. The nondeltaic part of the

district, about 50 feet higher, is likewise an open plain, sloping to the east and destitute of hills.

Rivers.—Cauvery River, a great river of southern India, rises in the Western Ghats in latitude $12^{\circ} 25'$ north, longitude $75^{\circ} 34'$ east; it then flows southeastward across the plateau of Mysore, and finally enters the Bay of Bengal by two principal mouths in the district of Tanjore. Its length is about 475 miles.

The Cauvery enters the Presidency of Madras at the Falls of Sivasamudram and passes into Trichinopoli, and at this part of its course is the historic Trichinopoli Rock, where the Cauvery breaks into two channels, the northern of which is named the Coleroon, which enters the bay southward of Porto Novo and is navigable for small craft for a few miles above its mouth.

The Vettar, another river in this district, enters the bay at Nagar.

Geology.—The south and southwest portions of Tanjore are occupied by unfossiliferous conglomerates and sandstones lying on an irregular surface of gneiss, and above them, in a series of flat terraces, are lateritic conglomerates, gravels, and sands, which gradually sink below the alluvium. The northern and eastern tracks are composed of river, deltaic and shore alluvium, and blown sands.

Flora and fauna.—Bamboos and coconut palms are plentiful in the delta, palmyras, and the Alexandrian laurel on the coast, tamarind, jak, and nim in the uplands of the south, while the iluppai and the banyan and other figs are common everywhere.

Antelopes, spotted deer, and wild hogs are found in the scrub jungle near Calimere Point, also in other very small areas, but otherwise there are no wild animals larger than a jackal; these and foxes are very common. Ordinary game birds are found in fair quantities and the rice fields afford good snipe shooting.

Population.—The population of the district in 1901 was 2,245,029, of which 86,974 were Christians and 91 per cent Hindus. Tamil is the general language spoken.

Products.—The fertility of the delta depends on the quantity of silt brought down by the Cauvery, and rice is grown in both June and August so as to take advantage of the two rainy seasons, but the deposit is so rich that the use of manure is very rare. The richest land lies near the apex of the delta, the fertility decreasing as the coast is reached; the poorest land is toward the southwest. Rice is, therefore, the staple grain of the delta, but varaga, cambu, and ragi are also grown, and tobacco, plantains, and bamboos.

On account of the delta being so closely cultivated it contains little grazing ground, so few cattle or sheep are bred, and plow bullocks are largely imported.

The chief industries are various kinds of weaving and metal work, for which Tanjore is somewhat celebrated.

Minerals.—There are few minerals of importance; quartz crystals are found at Vallam and laterite and limestone are abundant in the southwest district. Yellow ocher and gypsum of poor quality are found.

Trade.—The principal export is rice and, in addition, cotton piece goods, live stock, cigars, tobacco, skins, timber, and areca nut are shipped; inland exports are betel leaf, ground nuts, oil, metal vessels, and cloths. The imports include salt, gingelly, and cotton seed, kerosene oil, tamarinds, chillies, pulses, etc.

Ports.—The principal ports, all open anchorages, are Negapatam, Nagar, and Tranquebar.

Communications—Railways.—From Adraimpatnam a line runs to the northeastward and northward to Mayaveram and Negapatam, with a branch to the southwestward to Arantangi, and the South Indian Railway traverses the district in an east-northeast direction, passing through the towns of Tanjore, Kumbakonam, and Mayaveram.

Climate.—Although the delta is hot and relaxing the climate is generally healthy, and the increased breadth of the irrigated land as the delta widens causes more rapid evaporation of the water with which it is covered, rendering that part cooler than the sea. The mean temperature at Negapatam is 80°. A swamp westward from Calimere Point causes a great exception to the general healthiness, and this district is said to be malarious from April to June.

The annual rainfall, which is about 44 inches, is lowest at Arantangi and highest at Negapatam, where it is 36 and 54 inches, respectively; most of the fall is during the northeast monsoon.

Karikal.—Between Mayaveram, Nannilam, and Negapatam is the small territory of Karikal, belonging to the French, which has an area of 53 square miles. It was first promised to the French in return for assistance by an exiled Raja in 1738, but they did not obtain complete possession till 1754, and subsequently it came into the possession of the British on four different occasions, being finally restored to the French in 1817.

The settlement is divided into three communes, containing 110 villages, and is governed by an administrator subordinate to the governor of Pondicherri.

Population.—In 1913 the population was 60,154, and is rapidly decreasing.

Products.—The country is very fertile, being irrigated by seven branches of the Cauvery River, and the capital is situated on the

north bank of the Arasalar, about $1\frac{1}{2}$ miles from its mouth. Owing to its close proximity to Negapatam the trade has been very limited, but in 1908 it was said to be increasing. An American firm has built large iron tanks for the storage of kerosene oil, with a view to supplying the market in the interior.

Ports.—Karikal, the port, is merely an open roadstead.

Communications—Steamships.—Vessels of the British India, Messageries Maritimes, Clan, and Asiatic lines call here.

Railways.—Karikal is connected with Peralaim, on the Tanjore District Railway, by a line $14\frac{1}{2}$ miles in length.

South Arcot, the district joining the north side of Tanjore, is supposed to derive its name from arukadu, or six forests, that being the number with which it was credited. It lies between the parallels of $11^{\circ} 11'$ and $12^{\circ} 15'$ north, and the meridians of $78^{\circ} 38'$ and $80^{\circ} 0'$ east, and has an area of 5,217 square miles; its northern boundary is North Arcot and Chengalpat, and within it lies the French territory of Pondicherri.

The early history is probably the same as the rest of the Chola country, but before the British connection in 1674 it was also in the hands of the Pallavas and Mahrattas. Fort St. David and all the country "within the random shot of a great gun" was purchased from the Mahrattas in 1690, but the district only passed for the first time under British rule in 1781 and was ceded in full sovereignty to that country in 1801.

Physical features.—On the western side the Kalrayan Hills, from 3,000 to 4,000 feet high, are connected with the Shevaroy's, and farther north is part of the Javadi Hills; in the western and north-western parts are small rocky hills appearing in isolated groups, the most remarkable being Tiruvannamalai, a peak 2,668 feet high, with long sloping sides mostly covered with jungle.

The remainder of the district is a flat plain with a few sand ridges near the coast.

Rivers.—The rivers all flow from east to west, and Ponnaiyar, the principal one, has a course of 75 miles in a sandy bed with low banks and no tributaries of any consequence, falling into the bay 3 miles northward of Cuddalore.

In the extreme south the Vellar, flowing for 82 miles through the district, has high banks and enters the bay at Porto Novo, being tidal for 7 or 8 miles from its mouth; it forms the boundary between South Arcot and Trichinopoli.

The Coleroon has been already mentioned with Tanjore, and both it and the Vellar are navigable for a short distance from their mouths by small boats.

The Gadilam, southward of the Ponnaiyar and connected to it by a natural channel named the Malattar, runs into the bay close to the mouth of the Ponnaiyar, after a course of 59 miles. Northward of the Ponnaiyar is the Gingee or Varahanadi River, entering the bay near Pondicherri.

Geology.—Archæan gneisses and schists, with very massive gneissose, granite, hornblendic rocks, etc., are the chief geological features of the greater part of the district, and there are also unfossiliferous, ferruginous, soft sandstones and grits, with river, deltaic, and coast alluvium and blown sand in all the low-lying areas.

Flora and fauna.—In the hills there is an abundance of sandalwood (*Zizyphus* and *Terminalia*) and more rarely teak and black wood, while in the plain between the hills and the sea is a mixture of deciduous and evergreen flora; along the coast are the brackish water forms in the salt-water marshes and seaside coast flora along the beach; of these the seaside *convolvulus* and *spinifex* are conspicuous.

Leopards, bears, sambar, spotted deer, and wild hogs and some smaller game are found in the hills, and on the low ground are partridges, hares, quail, peafowl, jungle fowl, and rock pigeons, while teal, wild ducks, and snipe are numerous.

The principal sea fish are the pomfret, the sole, the whiting, the rubal, and the valai, a species of *silurus*.

Population.—In 1901 the population was 2,349,894, of which 94 per cent were Hindus, and of the Christians 92 per cent were Roman Catholics.

Products.—Rice is extensively grown, and cambu, varagu, and ragi are the chief staples in some parts; fruit and vegetables are grown in the vicinity of Cuddalore. Ground nuts form the most important industrial crop, gingelly is grown all over the district, and a considerable area is covered with indigo.

Cattle are raised and two kinds of sheep, one woolly and the other a hairy breed; goats are principally valued for their skins. The forests are not important and are at present principally used for grazing.

Indigo, salt, coarse sugar, pottery, oils, and cotton fabrics are largely manufactured, the indigo and steam sugar factories employing a number of hands. Weaving in cotton mixed with silk is also practiced.

Minerals.—The district is not noted for any mines or minerals, but fine grain sandstones, plastic clay, and excellent granite are found.

Trade.—The chief exports are ground nuts, oil cake, cotton piece goods, skins, rice, ground-nut oil, fresh vegetables, turmeric, tobacco,

cigars, chillies, coriander, and castor. This district does the largest trade in ground nuts in the presidency. Areca nuts, palmyra timber, cattle, fruit, and vegetables and many foreign-made articles are imported.

Ports.—Porto Novo and Cuddalore are the ports, the latter being by far the more important of the two.

Communications—Steamships.—The coasting steamers of the British India Co. call periodically at Cuddalore.

Railways.—The South Indian Railway runs for a distance of 88 miles through the district, with stations at Porto Novo and Cuddalore, and at Villapuram there is a branch 24 miles in length to Pondicherry. From Villapuram there is also a line to Dharmavaram in the Anantapur District.

There is a total length of 1,218 miles of road in the district, of which 901 miles are metalled.

Climate.—The climate of the district is fairly dry and generally healthy, but malaria is endemic in some parts, epidemic cholera is frequent, and elephantiasis is met with at some places along the coast. The temperature is moderate near the sea, the mean at Cuddalore being 82°, and average maximum and minimum 91° and 74°, respectively.

The district depends on the monsoons for its rains, which are greatest near the coast (52 inches), and get less farther inland, where they are 39 inches, the average annual fall being 43 inches.

Pondicherry, the chief French settlement in India, is situated about 12 miles north of Cuddalore, and has an area of 115 square miles. Founded in 1674, it was captured by the Dutch in 1693, but restored in 1699. The British besieged it four times—in 1748, in 1761, in 1778, and in 1793; the first siege was unsuccessful, and after the others the territory was restored, being finally given up to the French in 1816. The settlement has a number of isolated pieces of territory, surrounded by the British district of South Arcot.

Population.—The population of the whole territory, including Karikal, in 1913, was 276,198.

Products.—Weaving is the chief industry of Pondicherry, and there are four cotton mills, also a factory for the manufacture of cocotene, a substitute for ghi.

Trade.—The principal exports are ground nuts, shelled and in husk, oil cakes, cotton cloth, thread cotton, blue cloth, dried fish, hides, and rice, and imports cotton, pulse, grain, etc., gunny bags, areca nuts, wines, spirits, and shirtings. During the year 1907 the port was entered by 167 vessels, with an aggregate tonnage of 403,246 tons.

Port.—Pondicherri is a free port, but there is no real harbor, and vessels lie about 1 mile from the shore.

Communications—Steamships.—Vessels of the British India, Messagerie Maritimes, Clan, and Asiatic lines call regularly, and others, chartered for ground nuts, visit the port.

Railways.—Pondicherri is the terminus of the Villupuram-Pondicherri branch of the South Indian Railway, and is distant 122 miles by rail from Madras city.

Climate.—The climate is probably similar to that of South Arcot.

Chengalpat (Chingleput), the district joining South Arcot on the north, lies between the parallels of $12^{\circ} 15'$ and $13^{\circ} 47'$ north and the meridians of $79^{\circ} 34'$ and $80^{\circ} 21'$ east, and has an area of 3,079 square miles. It is bounded on the north by Nellore District and contains within its limits the city of Madras.

From the earliest records Chengalpat formed part of the ancient kingdom of the Pallavas until their extinction in 760, and shortly afterwards it became part of the Chola country. From 1393 to 1565 it belonged to the kingdom of Vijayanagar, and in 1639 the British received the grant of the site on which Fort St. George now stands, but it was not till 1801 that it became part of the British possessions in India.

Physical features.—The district is flat and dreary near the sea but undulating, and even in some places hilly, elsewhere; in the extreme north of the Nagalapuram Hills, about 2,500 feet, and the ridge, of which the highest peak is the well-known Kambakam Durgam, 2,546 feet, contribute a few picturesque effects.

Rivers.—A series of streams flowing from west to east cross this district, the largest being the Palar, which, rising in Mysore, runs into the bay 3 miles southward of Sadras.

Cotteliar River, the next important, falls into the backwater at Ennore northward of Madras City.

Other rivers are the Arani, which reaches the bay near Pulicat, and the Cooum, discharging near Fort George; besides these are the Cheyyar and the Adyar, two smaller streams.

Geology.—Archæan knessic and plutonic rocks emerge from the younger sedimentaries in the south and southwest part, and on these are plant-bearing shales, containing plants associated with sandstones and micaceous sandy shales and conglomerates, containing some ill-preserved ammonites and bivalves as well as plants.

In other places, above the plant-bearing shales, are thin beds of conglomeratic laterite, together with laterite red sands and loams. Along the coast and in the river beds are alluvium and blown sand.

Flora and fauna.—The most noticeable trees among the villages

are the palmyra palm and the casuarina, the latter being planted all along the sandy soil which borders the sea coast. The plants found throughout the district resemble those of similar areas on the east coast.

The larger kinds of wild animals are scarce, but an occasional tiger, a few leopards, and some bears are found among the hills in the north, also small numbers of spotted deer and sambar; here wild hogs are fairly numerous in the low hills and scrub jungle. The district is famous for snipe, and florican are more common than usual.

Population.—The population of the district in 1901 was 1,312,122, and owing to the proximity of Madras City it contains a large proportion of Europeans and Eurasians. Telugu is the language generally used.

Products.—The staple grains are rice and ragi, the other crops being varagu, indigo, gingelly, cambu, and ground nuts, but much of the soil is poor. There is little real forest, and it is chiefly used as grazing ground, but the cattle raised are mostly inferior.

Cotton and silk weaving are the most important occupations; there are some tanneries, paper-making establishments, and there is a cigar factory.

Trade.—The chief trade of the district is in supplying the city of Madras with ordinary local products, such as cow dung fuel, firewood, grain, vegetables, meat, straw, grass, sand, laterite, bricks, etc.

The imports are principally kerosene oil, European goods, and metals.

Ports.—Although the district has a long seaboard, with the exception of Madras, it possesses no place that can be called a harbor.

Communications—Steamships.—There is communication with Calcutta, Bombay, Rangoon, and the Straits by steamers of the British India Co.

Railways.—The main line of the South Indian Railway from the southward of the district crosses the Palar River by a girder bridge and runs to Madras. The East Coast Line of the Madras Railway, from Madras, runs to the northward and northwestward into Nellore District, and the southwest line of the same railway runs west into North Arcot, the main line connecting with the Great Indian Peninsula Railway to Bombay. A branch line from Chengalpat Town runs northwest to Arkonam Junction.

The district has 717 miles of roads, nearly all metaled, and about 600 miles have avenues of trees.

The Buckingham Canal, running along the whole coast of Chengalpat, utilizes the backwaters with which the whole shore is fringed and gives direct communication with South Arcot and with the north as far as Godavari.

Climate.—The climate, considering the latitude, is temperate like other districts in the southern part of the Province, the mean annual temperature of Madras being 83° , and although fever is endemic in some places in the west and leprosy and elephantiasis in the east, it is generally healthy.

The rainfall varies in different localities and is neither copious nor very regular. The average fall throughout is 45 inches, being greatest near the coast, where it is 51 inches, the greater part falling in the last three months of the year.

Nellore, bounded on the south by Chengalpat and on the north by the Guntur District, lies between the parallels of $13^{\circ} 29'$ and $16^{\circ} 1'$ north, and the meridians of $79^{\circ} 5'$ and $80^{\circ} 16'$ east, and previous to 1904 had an area of 8,761 square miles; it is the second largest district in the presidency of Madras.

It was apparently a part of the Chola Kingdom previous to the thirteenth century, when it passed to the Pandyas, becoming a Hindu Kingdom in the following century. The British connection dates from 1025, and in 1781 it first passed under direct British management, being ceded in full sovereignty in 1801.

Physical features.—The country rises very gradually to the Eastern Ghats on the west and the scenery is uninteresting, being generally wide extents of scrub jungle, but fine groves are occasionally met with in the vicinity of villages and tanks, with, in places, stretches of bright green rice.

Of the backwaters which separate the district from the sea, Pulicat Lake is the best known; the Kistnapatam Backwater has a depth of over 30 feet in the hot season at low water, but a bar, on which there is only 5 or 6 feet, blocks the entrance.

Rivers.—The principal rivers of the district are seven in number, but none are navigable except the Vupatteru, which allows boats drawing 2 or 3 feet water to ascend it for about 25 miles.

The Suvarnamukhi, the southernmost, rising in the Chittoor Hills, flows for 30 miles, and enters the bay 9 miles north of Armagon.

The Vupatteru, already mentioned, runs into the bay near Kistnapatam, and is tidal as far as Gudur, and northward of it is the Penner, the most important, on which is the town of Nellore; rising in Mysore, it has a course of 285 miles.

Farther north the other rivers are the Munyeru, the Paleru, the Musi, and the Gundlakamma, which latter forms the boundary with Guntur District.

Geology.—The central area is Archaean, and eastward of a north and south line through it are gneisses or schists, with some very

micaceous pegmatites, which have given rise to a considerable mica industry. Westward and southwestward of the central area are gneissoid granite, augite, etc., and some plant-bearing sandstones and shales. A narrow belt of alluvial and backwater deposits, from 2 to 14 miles wide, runs close to and parallel with the sea.

Flora and fauna.—Large trees, which are uncommon and generally found near villages, include the margosa and various species of ficus, the tamarind, the acacia, and the mango. The palmyra and coconut palm and the bastard date are found near the coast. A large part of the district is covered with low jungle scrub, in which the red-sanders tree and the satinwood, with a few other useful species occur.

Tigers occasionally wander across the border from the Cuddapah Hills, and bears are found on the Ghats and other hills, but are not plentiful. Leopards, hunting leopards, sambar, gazelle, and wild hogs are fairly common, and of birds the snipe and the florican are tolerably plentiful; the Indian bustard is occasionally seen.

Population.—There are 10 towns and 1,758 villages, and in 1901 the population was 1,496,987, of which nearly 60,000 were Christians and 90 per cent Hindus. This was prior to the formation of Guntur District.

Products.—The soil is fairly good near the sea but generally poor farther westward, and rice and cholam are the principal crops; tobacco, cotton, and indigo are grown, and castor is an important crop everywhere. The breed of heavy cattle is celebrated, but sheep and goats give very poor meat.

Beyond agriculture and cattle breeding, the industries are on a very small scale. The cloth is of the commonest description, and some rough woolen blankets are woven; brass and copper utensils are made in several localities. Country carts with stone wheels are made, and tanning skins is carried on.

Minerals.—Iron ore is widely distributed and there are large beds of magnetic iron; gypsum, garnet, laterite, crystalline limestone, sandstone, and greenstone are all found, and it is said that diamonds have been discovered.

Trade.—The principal exports are rice, grains, indigo, cotton, ghi, salt, oilseeds, condiments, firewood, salt fish, hides, horn, tobacco, limecloth, and brass and copper vessels. Of imports, the chief are hardware, petroleum, sugar, and spices. There is a large trade in cattle.

Ports.—There are no ports with any sea-borne trade, and the Buckingham Canal is the only navigable waterway.

Communications—Railways.—The East Coast line of the Madras Railway traverses the whole district from north to south.

Entering it 38 miles north of Madras, it leaves it, after running 153 miles roughly parallel to the coast, immediately northward of Ammanabrolu. From Gudur there is a line to Tirupati, and the Southern Mahratta Railway passes through the northwest part of the district.

Climate.—The climate is dry and fairly healthy, being subject to no sudden changes of temperature, but for two or three months of the year, when the westerly wind blows, the heat is excessive; owing to the sea breeze, that tract of country near the sea is generally cooler than inland. This district is regarded as one of the hottest in the Presidency, the average temperature at Nellore varying from 77° in January to 94° in May, the thermometer rising on some days to 112° in the shade. The mean annual temperature is 85°.

The rainfall is capricious and uncertain, being generally heavier on the coast than inland; the average at Pulicat Lake is 41 inches, while it is 36 inches in the south, 32 inches in the northeast, and 26 inches in the northwest of the district; as small a rainfall as 11 inches has been registered in one year.

Guntur District, which joins Nellore on its northeast side, was formed for administrative purposes in 1904 and extends to the west bank of the Kistna River, having an area of 5,733 square miles and a coast line of about 66 miles; the only river of any importance is the Kistna.

Population.—In 1901 the population was 1,490,635.

Ports.—Kottapatam and Nizampatan are the principal ports.

Kistna, the next district to Guntur, on the north, is bounded on its northeastern side by Godavari, and lies between the parallels of 15° 43' and 17° 9' north, and the meridians of 79° 14' and 81° 33' east; prior to 1904 it had an area of 8,498 square miles and is named after the large river, which, flowing along its western boundary, turns sharply from northwest to southeast and forms its most striking feature.

From the Buddhist dynasty, its earliest rulers, the district passed through a number of hands, and it was not until 1750 that the political influence of any European power was brought to bear on it, when it passed to the French and then to the British, becoming the territory of the latter in 1801.

Physical features.—The extreme west of the district consists of stony uplands, with rocky hills or low ranges. The central and northern portions are a level plain of black cotton soil, but the eastern part is the wide alluvial delta of the Kistna River, an almost flat expanse covered with irrigated rice fields and containing some of the most fertile land in the presidency. The coast is fringed with

a belt of blown sand, sometimes extending inland for several miles. and with dunes from 30 to 50 feet high.

The only hills, which are outliers of the Eastern Ghats, are on the western side, and Colair Lake lies within the district.

Rivers.—The Kistna River, the only one in the district, rises in the Western Ghats, about 40 miles from the Arabian Sea, and has a total length of 800 miles, being one of the largest rivers in southern India. In its course it receives a number of tributaries, viz, the Koyna, the Varna, the Panchganga, the Ghatprabba, the Malprabba, the Bhima, the Tungabhadra, and the Musi, which is its last important feeder; and from the Eastern Ghats it flows for 100 miles between the Kistna and Guntur Districts, at which point it is first largely used for irrigation.

At Bezwada, at the head of the delta, the river is thrown out into a network of irrigation canals from a masonry dam, and here the East Coast Madras Railway crosses it on a girder bridge, and it is said that the velocity of the current is about $6\frac{1}{2}$ miles an hour when the river is in flood. The river is only navigable below the dam, between which and its mouth sea-going native craft ply on it for six months of the year.

Colair Lake, the only large natural fresh-water lake in the Madras Presidency, is a large, shallow depression, half lake, half swamp, and, roughly, elliptical in shape; its extent varies greatly, as, during the monsoon, it exceeds 100 square miles, while in the dry season it shrinks considerably and even sometimes dries up altogether.

It has two outlets, the Perantala Kanama and Juvir Kanama, and passes into the tidal stream of the Upputeru, and thence to the sea.

Canals.—From the masonry dam above mentioned, which is 3,714 feet long and 20 feet above the bed of the stream, there are 10 principal canals leading to every part of the delta, and 307 miles of these are navigable.

Geology.—Archæan gneisses cover the belt of low-lying country at the foot of the Eastern Ghats, and northwestward of this there is more elevated country of unfossiliferous sedimentary strata, comprising quartzitic and shaly subseries, with occasional conglomerates and limestones. Southeast of the Archæan band are plant-bearing sandstones and shales and Jurassic marine shells, and there are great stretches of coastal and deltaic alluvium.

Flora and fauna.—The district, generally speaking, is very bare of tree growth, but considerable areas of the sandy wastes along the coast have been planted with casuarina, and a light wood, named ponuku, used in the manufacture of toys, is found in the hills. The plants are merely the usual cultivation weeds of this coast.

Wild animals are not plentiful, but tigers and sambar are found in some of the jungles and on the hills. A few antelope are seen, and wild hogs are not uncommon in various parts. Almost every species of South Indian feathered game, except woodcock and hill partridge, may be found in the district, and Colair Lake holds all the known aquatic birds and is also fairly stocked with fish.

Population.—In 1901 the population of the district was 2,154,803; of these about 100,000 were Christians and 89 per cent Hindus; Telugu is the prevailing language. This was prior to the formation of Guntur District.

Products.—Rice is the staple crop, and cholam and cambu are also extensively grown; cotton, indigo, tobacco, and castor are the principal industrial crops. The large extent of pasture in the upland regions affords exceptional facilities for rearing stock and excellent cattle are raised; sheep are also fairly plentiful.

The arts and manufacturers are few, but weaving coarse cloth from sheep and goat wool is carried on all over the district; there are steam cotton presses and ginning factories; toys are made, and there is a tannery.

Minerals.—Iron occurs in small quantities, and copper was formerly found; the diamond mines, worked before the British occupation, are said to have produced some of such celebrated stones as the Pitt or Regent, and, it is supposed, the Koh-i-noor.

Trade.—Cotton, rice, castor seeds, tobacco, and chillies are the principal exports, and among the imports are coarse sugar, spirits, piece goods, and kerosene oil.

Ports.—Masulipatam and Narasapur are the two seaports.

Communications—Steamships.—The British India Steam Navigation Co. have a regular service of steam vessels to Masulipatam.

Railways.—The most important railway is the East Coast line of the Madras Railway, which, entering the district from Nellore at its southern corner, runs through it for 93½ miles and passes into Godavari; it crosses the Kistna River on a 12-span girder bridge. Bezvada is also the terminus of the Guaranteed State and Southern Mahratta Railways; the former leaves the district at 21½ miles from Bezvada and the latter has a length of 79 miles within it. A line is in course of construction from Masulipatam to Bezvada.

There are 709 miles of metalled roads, and nearly that length planted with avenues of trees.

Climate.—The climate, although trying on account of the great heat, is fairly healthy, and fever is on the whole uncommon. Masulipatam has a mean temperature of 82° and a recorded shade temperature of 117°, the minimum being 58°, and except for a short time in May the heat is never unbearable.

The annual rainfall of the whole district is 33 inches, but it is not evenly distributed, and two-thirds of it falls during the southwest monsoon, the remainder falling in the last three months of the year.

Godavari, bounded by Kistna on its southwest side and by Vizagapatam on the northeast, lies between the parallels of 16° 19' and 18° 4' north, and the meridians of 80° 52' and 82° 36' east, and has an area of 7,972 square miles.

The earliest rulers of the country were the Andhras, from which it passed to the Asokas and Pallavas and then to the Cholas till the end of the thirteenth century. In the fourteenth century the Mohammedans appeared on the scene and there were various changes. The first European settlement was founded in 1652, and in 1765 the district passed to the British. In 1879 certain taluks and the Rampa hill country were constituted an agency, giving extended powers to the collector.

The French possession of Yanam or Yanaon is included in this district.

Physical features.—The northwestern angle of the district, known as the agency tract, is almost entirely occupied by a portion of the range of the Eastern Ghats, consisting of scattered hills and spurs; the highest peak is Peddakonda, 4,476 feet high. The Godavari River, from which the district takes its name, runs directly through the center of the district, dividing, at 40 miles from the sea, into two branches, and flowing through a wide delta formed by its silt, and from this to the sea the country is a vast expanse of rice fields, dotted with gardens and villages. The alluvial tracts on the right and left banks of the river are designated as the Western and Eastern Deltas.

Rivers.—The Godavari River, for utility, sanctity, and picturesque scenery, is only surpassed by the Ganges and Indus, and, rising in Nasik District, Bombay, only 50 miles from the Indian ocean, flows in a southeast direction for about 900 miles. Its tributaries are the Darna, the Kadva, the Pravara, the Mula, the Purna, the Manjra, the Maner, the Pranhita, the Wardha, the Wain ganga, the Indravati, the Tal, and the Sabari.

The head of the delta of this river is at Dowlaishweram, in the Godavari District, and 40 miles in a straight line from the Bay of Bengal, and here it bifurcates, forming the Vasishita Godavari on the west and the Gautami Godavari on the east; above the bifurcation is a masonry dam or anicut, formed of two parallel walls, 2½ miles in length, and 42 feet apart. The river is navigable for small boats throughout the district, and above the dam there are several Government steam vessels.

There are no other rivers of any consequence in the district.

Canals.—Three separate canal systems branch off from below the dam, of which there are 493 miles of main canal, all navigable; in addition to this there are 1,929 miles of distributary canals.

Geology.—The geology of the district is somewhat complicated, with Archaean gneissic rocks in its northwest portion, and on the other formations rest the deposits of the plains and of the Godavari Valley.

Flora and fauna.—The forests are of great value and situated chiefly within the agency limits. The principal tree is the teak, and of items of minor produce are the tamarind and myrabolams; along the coast are large tracts of mangrove swamps and there are three casuarina plantations. The physical formation of the district permits the existence of several distinct floras, and bordering the river and in the rapids *Euphorbia Lawii* flourishes, and some exotic ferns are found on its banks.

Bison frequent the tablelands, and wild buffalo are occasionally met with, while in the plains antelope, spotted deer, and wild hogs are to be found in several localities. The district is rich in bird life and among the rarer birds are the imperial pigeon, pied myna, and bhimaraj. The large sable fish is caught in considerable quantities at the dam across the Godavari river and soles are plentiful off the coast.

Population.—In 1901 the population was 2,301,759, of which only about 17,000 were Christians and 97 per cent Hindus; there are 2,678 towns and villages, nearly one-half being in the agency. Telugu is the language generally spoken.

Products.—Rice is grown on about half the area cropped; next comes cholam, and pulses, chiefly horse gram and green gram. Of the industrial crops, oilseeds, tobacco, sugar cane, and indigo may be mentioned, and a large area is under orchard and garden crops. There are no distinctive breeds of cattle, but large flocks of sheep and goats are kept.

Coarse cotton cloths and woollen blankets are made, also woollen carpets; there are sugar, rice husking, castor oil, indigo, cheroot, and salt factories, fish-curing yards, and a small iron foundry.

Minerals.—Prospecting for coal has been carried on for some years, and although two outcrops have been found no paying seam has been discovered. Graphite is worked; there are traces of iron workings throughout the agency and in the delta are two small deposits of sulphur.

Trade.—The exports from the district consist almost entirely of agricultural produce, the chief items being rice and other grain,

tobacco, oilseeds, ghi, coconuts, hides, and fruit, and cotton brought from Deccan is largely exported. The principal imports are cotton twist and yarn, piece goods, grain and pulses, kerosene oil, gunny bags, and sugar. Opium is also a noteworthy article of import.

Ports.—The district has 172 miles of seaboard, but the only port with any trade is Cocanada, and the anchorage is a considerable distance from the shore. Bandarmalanka and Upada are subports.

Communications—Steamships.—The British India Co. has a regular weekly service of steamers from Rangoon, touching at Cocanada and intermediate ports, but as many as six or seven steamers of this line call weekly. The Asiatic Steam Navigation Co. and the Clan Line have weekly steamers, and those of the Austrian Lloyd and of a Venetian company touch irregularly.

Railways.—The East Coast line of the Madras Railway enters the district about 10 miles westward of Ellore, and running along the fringe of the delta crosses the Godavari River at Rajahmundry on a steel girder bridge over $1\frac{1}{2}$ miles long on masonry piers. From Cocanada a branch runs for 10 miles to Samalcot, and thence to Rajahmundry.

There are 918 miles of metaled roads, 814 miles being planted with avenues of trees.

The canals, the most important means of communication in the district, have been mentioned with Godavari River, on which latter there are ferry steamers.

Climate.—The district is generally healthy, but fever is very prevalent, especially during the cold season, and this is particularly the case in the agency tracts, where it is of a virulent type in some parts; beriberi is common along the coast.

The mean temperature at Rajahmundry averages 82° , with a mean range of 18° , but the humidity of the atmosphere renders the heat oppressive. The average rainfall is 33 inches, two-thirds of which falls during the southwest monsoon, setting in about the middle of June, with practically no rain in the first four months of the year.

Vizagapatam, the district lying next northeastward of Godavari, and bounded on its northeast side by Ganjam District, is the largest in the presidency and one of the largest in India; it lies between the parallels of $17^{\circ} 15'$ and $20^{\circ} 7'$ north and the meridians of $81^{\circ} 24'$ and $84^{\circ} 3'$ east, and has an area of 17,222 square miles.

The district has apparently passed through the hands of the Andhras, the Pallavas, the Cholas, and was overrun by the Mohammedan armies about 1480. A factory of the East India Co. was founded in the middle of the seventeenth century, but in 1757 fell into the hands of the French, and again in 1794 into British power,

and the present district was formed of three collectorates in 1802. Here there is also an agency tract, which includes 12,622 square miles.

Physical features.—The district is for the most part hilly and picturesque, especially in the north, but in the south there is a cultivated plain, divided from the hilly part by a portion of the Eastern Ghats, which, passing from southwest to northeast through the district, average from 2,000 to 3,000 feet in height forming the main watershed.

Rivers.—Owing to this main watershed passing through the center of the district, the rivers are usually short, and those falling into the Bay of Bengal are irregular in flow and of no importance for irrigation or navigation.

Geology.—The fundamental rocks are gneisses and igneous rocks of the Archæan group, which outcrop mainly in lines running northeast and southwest; the surface rocks include pisolitic laterite, containing a considerable amount of hydrated alumina, which will probably become valuable as an ore of aluminium. Other recent deposits include the alluvium of the plains and older red laterite loam.

Flora and fauna.—The flora varies with the variations of altitude and moisture which occur; salt-water plants being found along the shore, the ordinary trees and plants of the east coast on the plains further west, and the flora characteristic of the moist regions of the presidency on the hills.

The wild animals, usual in South Indian forests, are abundant in the hilly country, and especially in the more remote parts, which are considered to be the best game tracts left in Madras, but only special notice is necessary in the case of the wild buffalo (*Bos bubalus*) found in some parts of the district, and nowhere else in the presidency.

Population.—The district contains 12 towns and over 12,000 villages, the greater number being small, and in 1901 the population was 2,933,650, of which 99 per cent were Hindus, the proportion of Mohammedans and Christians being smaller than any other district, except Ganjam. Telugu is the language of the plains, but in the hill country the greatest confusion of tongues prevails.

Products.—A peculiarity of the district is the multiplicity of its crops and harvests, as, with the exception of about two months—from March to May—cultivation and harvesting are continually going on. Rice, cambu, ragi, and pulses are grown, and of the industrial crops are gingelly, sugar cane, cotton, tobacco, and indigo. Cattle are small, and goats and sheep are chiefly kept for their manure. Workable iron ores exist, but are only smelted for local use, and manganese ore is the only mineral extracted to any extent.

There are no arts nor manufactures of any importance, but weaving common cloth goes on in nearly every village; there is a distillery, which manufactures country spirits, and also a jute factory.

Trade.—The exports are chiefly manganese ore, hides and skins, grain, and raw sugar; and imports, cotton piece goods, twist and yarn, hardware, iron, and timber.

Ports.—The two principal ports are Vizagapatam and Bimlipatam.

Communication—Steamships.—The British India Steam Navigation Co. have a weekly service of steamers to Vizagapatam and Bimlipatam.

Railways.—The East Coast Railway runs along the coast from southwest to northeast, for a distance of 137 miles, with a short branch to Vizagapatam. From the town of Vizagapatam a line is in course of construction to Raipur, in the central provinces, passing through Paravatipuram.

There are nearly 1,000 miles of roads, of which 370 miles are metalled, and 537 are planted with avenues of trees.

Climate.—The climate is moist and relaxing along the coast, hotter and drier inland, and wettest and coldest in the hills, and the most prevalent disease is malarial fever, which differs in intensity according to the locality, being of a comparatively mild type on the plains; beriberi and elephantiasis are common chiefly on the coast.

The rainfall, principally during the Southwest monsoon, is heaviest north of the Ghats, in Jeypore, and lightest along the coast, the average at the former being 66 inches and at the latter 38 inches, with an average of 43 inches on the plains; the yearly mean temperature of Vizagapatam town is 82° , the climate being pleasant in the cold season, although somewhat relaxing at other times.

Ganjam, the northernmost district of the Madras Presidency, is triangular in shape, the apex being at its southern end; it lies between the parallels of $18^{\circ} 12'$ and $20^{\circ} 26'$ north, and the meridians of $83^{\circ} 30'$ and $85^{\circ} 12'$ east, and has an area of 8,372 square miles.

Conquered by the Asokas in 260 B. C., it passed a little later to the Andhras, who were driven out in the third century to make room for the Gangas, who were succeeded by the Cholas about the end of the tenth century, and for nearly 200 years after 1571 the country was ruled by Mohammedans, till, in 1757, the French obtained some tracts of land, which were captured by the British in 1759. In the early part of the eighteenth century the district was much disturbed, but in 1836 it was quieted down, and no disturbances of any importance have taken place since.

Physical features.—A considerable portion of the district is mountainous and rocky, but it is interspersed with valleys and fertile plains, with pleasant groves of trees, which, with its background of

wild hills, often covered with dark jungle, renders it one of the most beautiful districts in the presidency.

The Eastern Ghats traverse it from south to north and are nowhere more than 50 miles from the sea, being only 15 miles at Baruva, in the center of the district, and here Singarazu and Mahendragiri Peaks, the two loftiest in the district, are nearly 5,000 feet; Devagiri, 4,535 feet, the next highest hill, is farther south.

Rivers.—Three principal rivers, all used for irrigation, flow into the bay, of which the Langulya is the southernmost, forming, for the last 30 miles of its course, the southern boundary of the district, and entering the sea 3 miles from Chicacole, where it is crossed by the trunk road on a fine bridge. The Vamsadhara, the next to the north, runs into the bay at Kalingapatam, and the Rushikulya drains the northern part of the district, discharging at Ganjam.

Geology.—The exposed rocks are Archaean gneisses and schists, with bands of granite formation, and at an elevation of 4,000 feet are capped with horizontal laterite, while in the flat coast region, except where there are rocky ridges and hills, recent alluvium and laterite red clay are generally present.

Flora and fauna.—Scrub jungle covers a large extent of the wooded area near the coast, with tree forest farther inland, and the herbaceous flora is made up of plants belonging to both dry and moist regions; the most characteristic forest tree is sal (*Shorea robusta*), and in some places along the coast casuarina has been planted.

Bears and hyenas are common, and wolves, leopards, and tigers are also met with; sambar, spotted deer, barking deer, and moose occur on the slopes of the hills, and antelopes are found in the plains; wild dogs are abundant.

Population.—The district contains 8 towns and over 6,000 villages, most of the latter small; in 1901 the population was 2,010,256, with fewer Mussulmen and Christians than any of the other districts of the presidency. Telugu is mainly spoken in the southern, and Oriya in the northern portion of the district.

Products.—Rice is the most important crop, covering nearly three-fourths of the cultivated area, with ragi next, covering one-sixth; other important crops are green gram, horse gram, and gingelly, and the products of the forest areas are alum, arrowroot, myrabolams, gall nuts, and oranges, while mango trees are scattered around the villages. Bullocks and buffaloes, bred locally, are inferior and undersized animals.

There is a sugar factory and a distillery for country spirits, a tannery, and a salt factory; sea and river fisheries constitute an important industry. There are no mines, but manganese ore has been found in small quantities, also mica, antimony, ore, and corundum.

Trade.—The principal exports are grain, pulses, myrabolams, hides and skins, oilseeds, turmeric, wood, salt, salted fish, and coconuts. The imports are mainly rice, piece goods, twist glassware, metals and metal goods, kerosene oil, spices, and gunny bags.

Ports.—The three ports are Kalingapatam, Baruva, and Gopalpur, the first and last being open to foreign as well as coasting trade.

Communication—Steamships.—The British India Steam Navigation Co. have a weekly service of steam vessels to the above ports.

Railways.—The East Coast section of the Bengal-Nagpur Railway runs through the district, nearly parallel to the coast, with a branch at Naupada to the estates of the Raja of Parlakimedi.

Of a total of 729 miles of metaled roads, 650 miles are planted with avenues of trees.

Climate.—With the exception of Ganjam town, which is exceedingly malarious, the coast climate is usually cool and healthy, and the district is one of the few in the presidency which enjoys a really cold season.

The rainfall is usually considerable, and that in the southwest monsoon is heavier inland than on the coast, while the reverse is the case in the northeast monsoon; in both monsoons it is heavier in the northern part than in the southern part. The fall for the whole district averages 45 inches, and for the agency 55 inches.

Bihar and Orissa.—A new province has been constituted, that of Bihar and Orissa, including the coast districts of Puri, Cuttack, and Balasore, with the seat of government at Bankipore.

Bengal, formerly the largest and most populous province in India, with an area of nearly 190,000 square miles, has recently undergone changes in its constitution, and now comprises (1911) 78,699 square miles; the divisions on the sea coast, from west to east, are, respectively, Orissa, Burdwan, and the Presidency division.

As the early history of the Province is somewhat complicated, it seems sufficient to mention that the Portuguese in 1530 were probably the first European traders, the Dutch settled in some parts in 1625, and the first East India Co.'s factory was established near Balasore in 1642. The French established themselves at Chandernagore in 1688, and this was captured by the British, but afterwards restored. In 1756 the Nawab of Bengal took Calcutta, and the Black Hole massacre occurred, followed by Clive's victory in 1757, since which various changes have taken place in the constitution and government of the Province. It was placed under a lieutenant governor in 1854, who is assisted by a legislative council.

Physical features.—The main axis of the Himalayas near the northern frontier of the Province has some of the highest peaks in the world, as Mount Everest (29,002), Mount Kinchinjunga (28,150), Mount Devalagiri (26,826), and others of as nearly as great altitude.

From Mount Kinchinjunga the Singalila range extends to the southward, forming the boundary between Nepal and Darjeeling, the peak of the same name as the range, being 12,130 feet above high water.

The most distinctive feature of the district is its network of rivers, which, with their affluents and distributaries, afford means of communication, and are useful for irrigation purposes, and for their supply of fish.

The Ganges, rising from an ice cave at the foot of the Himalayas, at an altitude of 13,800 feet, has a general easterly course from the western frontier of the district, with various changes in direction; as far as Rajmahal, and in this part receives the following tributaries, viz: The Gogra, the Son, the Gandak, and the Kosi. From the Rajmahal Hills it turns sharply to the southward, and about 20 miles farther on commences to branch out over the level country, being here about 300 miles, by its windings, from the Bay of Bengal.

The Hugli is its westernmost and most important mouth for the purposes of navigation, and on it stands the city of Calcutta; the Meghna is in the easternmost mouth, and among the number of others between may be mentioned the Matla, Raimangal, Malancha, and Haringhata; between the Hugli and the Meghna is the Ganges delta.

There are services of steamers along its whole course within Bengal, and, of the many towns lying on its banks, Patna and Monghyr are the most important.

The Brahmaputra, having its source at no great distance from the Ganges, but on the other side of the Himalayas, joins the Meghna, and discharges by that mouth.

Geology, etc.—The geology, flora, fauna, etc., of that portion of Bengal which borders the sea coast, will be described with the various districts.

Population.—The population, as now constituted, is 50,722,067, of which nearly 78 per cent are Hindus, and only about 5 per cent live in towns. The principal languages are Bengali and Hindustani.

Products.—The chief products of the Province are rice, opium, indigo, oilseeds, sugar, tobacco, silk, tea, and jute, and in the hills bordering the great plain are coal measures yielding the greater part of India's coal output.

Districts.—The districts of Bengal on the coast are Midnapore and 24 Parganas and Khulna, the last two including the Sundarbans or Ganges Delta.

Puri, the southernmost district, is triangular in shape, lies between the parallels of 19° 28' and 20° 26' north, and the meridians of 84° 56' and 86° 25' east, and has an area of 2,472 square miles; it joins Ganjam on the west and is bounded on the east by Cuttack District.

Since this district passed to the British, in 1804, the only noteworthy political events in connection with it are the rebellion of the

Raja of Khurda in 1804 and the rising of the paiks or landed militia in 1817.

Physical features.—The district may be divided into three tracts, viz, the western, central, and eastern. In the first is Chilka Lake, about 35 miles in length, and on its northern side are spurs from the hills farther north, extending to its shore, with fertile valleys between them. The middle and eastern tracts consist entirely of alluvial plains, watered by a network of channels.

The coast line is a belt of sandy ridges, varying from a few hundred yards to about 4 miles in breadth, and in the eastern part is Sar Lake, a back water of the Bhargavi River.

Rivers.—The most important rivers are the Nun, the Daya, and the Bhargavi, all entering Chilka Lake; they are mostly shallow in the dry season, but come down very heavily during the rains. The Kushbhadra, the only river entering the sea, has a very winding course and is of little value for navigation.

Geology.—The hills are composed of compact gneiss, or garnetiferous rock, with bands of quartzose gneiss with a raised terracelike plain of laterite around them, which also probably underlies the recent alluvium of the eastern part of the district. A bed of mud with estuarine shells is found on the southern shore of Chilka Lake.

Flora and fauna.—The red cotton tree, some palms and Tamarindus indica grow near villages; mangroves cover banks of rivers and creeks, and ponds and ditches have water weeds or submerged water plants.

Small game is plentiful, but in the open part of the country large animals are nearly extinct.

Population.—The population numbered 1,017,284 in 1901, of which more than 98 per cent were Hindus and the remainder Mohammedans; the language generally spoken is Oriya.

Products.—Rice and pulses are the chief crops, and castor oil, sugar cane, cotton, indigo, tobacco, and vegetables are also grown. Cattle are reared.

Laterite, lime, and sandstone are found, but no quarries are worked.

Cotton cloth, brass and bell-metal utensils, brass, gold, and silver ornaments, and wickerwork baskets are manufactured.

Trade.—The chief exports are rice, gram, pulse, unrefined sugar, coconuts, brass, and silk, and imports raw cotton, piece goods, refined sugar, spices, nuts, iron, tobacco, kerosene oil, salt, and copper.

Ports.—Puri is the port and only town.

Communication — Steamships.—The steamers of the British India Steam Navigation Co., running between Cocanada and Rangoon, call at Puri if there is an inducement to do so.

Railways.—The East Coast section of the Bengal-Nagpur Railway passes from southwest to northeast through the whole district, with a branch, 28 miles long, connecting Puri and Khurda. The district is also well supplied with roads.

Climate.—Although directly on the track of the cycloidal storms, experienced frequently during the monsoon season, the sea breezes usually maintain an equable climate in the district. The mean temperature, which is 86° in the hot months, falls to 84° in the monsoon season, and to 77° in February, the average maximum temperature being 89° in April and May. The annual rainfall averages 58 inches, of which about 42 inches falls between June and September, both inclusive. The humidity ranges from 75 per cent in December to 86 per cent in August.

Cholera is imported annually by pilgrims; fever is prevalent during the cold season, and smallpox occasionally appears in a virulent form.

Cuttack, the district lying next northeastward of Puri, is between the parallels of $20^{\circ} 2'$ and $21^{\circ} 10'$ north, and the meridians of $85^{\circ} 20'$ and $87^{\circ} 1'$ east, and has an area of 3,654 square miles; it has no separate history.

Physical features.—It consists of three distinct tracts, that along the sea coast being a marshy, jungle-covered strip, from 3 to 30 miles in breadth, with behind it an arable tract of rice land, and then a broken, hilly region along its western boundary. The strip first mentioned is intersected by innumerable streams and creeks, and the arable plain by the large rivers which flow from the western mountains. A few isolated hills stand in the plains, the chief being Naltigiri, Udayagiri, and Assia, the second having a colossal image of Buddha, and the last 2,500 feet high, the highest point in the district.

Rivers.—The most conspicuous feature of the district is its rivers, of which the Mahanadi, or Great River, after many interlacings, forms two great estuaries, the Devi, the western, entering the Bay of Bengal at the south part of the district, and the Mahanadi, the eastern, near False Point.

The Baitarani and the Brahmani, meeting before they reach the sea, flow into the bay at Palmyras Point, as the Dhamra. The chief offshoots of the Mahanadi are the Katjuri, Paiki, Birupa, and Chitaratala, and the Kharsua is an important tributary of the Brahmani.

Canals.—The greater part of the Orissa Canal system lies within the limits of this district, and consists of the following canals, with their respective lengths: The Machgaon, 32 miles; the Taldanda, 52 miles; the Kendrapara, 39 miles; the Gobri, 15 miles; the Patamundal, 47 miles; the High Level Canal, $45\frac{1}{2}$ miles; and the Jaipur, $6\frac{1}{2}$ miles.

Geology.—South of the Brahmani River are numerous gneissic hills, the gneiss for some miles being compact, but further south assuming a more or less decomposed form, which, being easy to work, is occasionally quarried. The plain to the south is covered with laterite, with gneiss at intervals, and the hills near the Mahanadi are formed of coarse grits, sandstones, and conglomerites.

Flora and fauna.—The flora is somewhat similar to that of Puri.

Tigers, bears, leopards, wild buffaloes, antelopes, spotted deer, hyenas, jackals, foxes, and wild hogs are found. Fish-eating and man-eating crocodiles, growing to a very large size, abound in all the rivers and creeks.

Population.—In 1901 the population was 2,062,758, of which 97 per cent were Hindus; the language of the district is Oriya.

Products.—Rice is the principal grain cultivated, and pulses, oil-seeds, sugar cane, tobacco, potatoes, and betel leaf are also grown; cattle and sheep are bred. Cotton weaving is extensively carried on: the silver filagree work is well known, and other manufactures are bell-metal work, lac and brass ornaments, pottery, hardware, gunny bags, baskets, etc.

Trade.—The chief exports are rice, oilseeds, hides, jute, timber, horns, lac, nux vomica, beeswax, resin, and silver filagree work. The principal imports consist of piece goods, kerosene oil, crockery, glass-ware, fancy goods, metals, yarn, betel nuts, and spices.

Ports.—False Point is the principal port.

Communication—Steamships.—Steamers ply three times every week from Cuttack City to Chandbali by canal, and from Chandbali to Calcutta by sea; cargo steamers call irregularly at False Point.

Railways.—The Cuttack-Midnapore extension of the Bengal-Nagpur Railway runs from southwest to northeast through the district. Of about 800 miles of roads, over 700 miles are unmetaled.

Climate.—The extremes of climate are more marked than in any other part of Bengal, and cyclonic storms frequently cross the district, which lies directly in their track. The mean temperature falls from 88° in the hot months to 83° in the monsoon, and to 69° in February; the average maximum temperature in April and May is 102°. Of the annual rainfall, which averages 60 inches, about 55 inches falls between May and October, each inclusive.

The district is especially liable to smallpox.

Balasore, the northern district of Bihar and Orissa, is situated between the parallels of 20° 44' and 21° 57' north and the meridians of 86° 16' and 87° 31' east, and has an area of 2,085 square miles. Its early history presents no special feature of interest; although a factory was established in 1633, the district did not become British property until 1803.

Physical features.—The district consists of a strip of alluvial land lying between the sea and the hills which rise from the western boundary, and which has a breadth of about 40 miles in the south, 10 miles in the middle, and 30 miles at its northeast extreme.

Rivers.—The Baitarani, forming the boundary between Cuttack and Balasore, and which, after its junction with the Brahmani, is named the Dhamra, is navigable as far as Olokh, about 15 miles from its mouth, after which it is not tidal, and can be forded in the hot season.

The Kansbans, subject to sudden freshets, discharges by two mouths, the southern named the Gammai (Gamai).

The Burhabalang, on which is Balasore Town, has a tortuous course of 35 miles, 21 miles of which is tidal, and, although barred at its mouth, admits small vessels which reach the town.

The Panchpara Nud is tidal for 10 miles, and in some parts is navigable for large boats.

The Subarnarekha, the northern river, has a course of 60 miles in the district and communicates with the coast canal at Jamkunda Lock; it is largely used by Calcutta country boats.

Geology.—The Nilgiri Hills consist of granitoid gneiss, and bands of a chloritic rock, approaching serpentine in texture, and along the base of the hills laterite occurs. In the southwest part quartz schist comes in.

Flora and fauna.—Red cotton trees, tamarindus indica, banyans, and palms are grown near villages, and open glades are filled with grasses, sometimes reedy; sedges abound, and ferns are fairly plentiful.

Black bears are found in the north and tigers, leopards, hyenas, spotted deer, antelopes, hogdeer, moose, civet cats, and hares are common in the more jungle portions.

Population.—In 1901 the population was 1,071,197, of which about 96 per cent were Hindus; Oriya is the language spoken.

Products.—Rice is the great crop, as pulses and oilseeds, also grown, are of minor importance. The cattle reared are similar to those common in South Bengal.

Cotton weaving and mat making are carried on, and brass and bell-metal articles are manufactured. Laterite, found in the western part of the district, is used for building purposes.

Trade.—The exports are rice, hides, jute, oilseeds, timber, and stoneware, and imports European cotton piece goods, oil, salt, and spices.

Ports.—The ports are Chandbali and Balasore.

Communication—Steamships.—Chandbali has communication by steamers four times weekly, and Balasore once every week, with Calcutta by those of the Indian General Steam Navigation Co.

Railways.—The Bengal-Nagpur Railway runs for 88 miles through the district connecting it with Calcutta, Cuttack, and Madras, and from Rupsa junction there is a branch line to Baripada. A coast railway, connecting Chandbali and Balasore, is contemplated, also a light railway from Balasore to the Nilgiri stone quarries.

Climate.—The extremes of climate are the same as those mentioned for Cuttack. The mean temperature falls from 89° in the hot months to 83° in the monsoon, and to 74° in February, the average maximum in April and May being 98°. The average rainfall is 60 inches, of which 55 inches falls between May and October, both months inclusive. The humidity ranges from 79 per cent in April and May to 80 per cent in August.

The district suffers from severe epidemics of cholera; elephantiasis is extremely common, and fever prevails in the cold season, but the country is singularly free from malaria, except in one part.

Burdwan has been already mentioned as one of the divisions of Bengal.

Midnapore (Midnapur), the southern district of Burdwan, lies between the parallels of 21° 36' and 22° 57' north, and the meridians of 86° 33' and 88° 11' east, has an area of 5,186 square miles, and is the most populous of the Bengal Regulation Districts. The district came under Buddhist influence early in the fifth century, and the British occupation dates from 1760, the chiefs of the hill country giving considerable trouble during the early years of administration.

Physical features.—It contains three tracts of well-marked character—the north and west of laterite formation, the east deltaic, and the south seaboard, and the greater part of the district is generally level, but in the northwest are several hills over 1,000 feet high; all the eastern part is deltaic.

Rivers.—The chief rivers are the Hugli and its three tidal tributaries, the Rasulpur, the Huldia, and the Rupnarayan. Hugli River, the westernmost, and, for commercial purposes, the most important, channel which discharges the waters of the Ganges, is formed by the confluence of three streams—the Bhagirathi, the Jalangi, and the Matabhanga—which are collectively known as the Nadia Rivers.

From near the vicinity of Nadia Town, it receives its name of Hugli, and it may be divided into two sections, the first from Sagar Island, where is the estuary, to Calcutta, a distance of about 80 miles, the second section being from Calcutta to Santipur, a distance of 64 miles.

On its right bank it receives four tributaries, the Damodar joining it 35 miles below Calcutta, and the remaining three which have been already mentioned. It is tidal as far as Nadia, especially during the

dry season, when the tidal inflow of four months is said to be more than double the fresh-water discharge of the year.

Below Calcutta the changes in the channel are frequent, and this, combined with the tidal streams, makes navigation difficult, and in the estuary are several dangerous sand banks, continually changing, but certain parts of the river are sounded daily, and the result telegraphed to Diamond Harbor and Calcutta, for the information of inward and outward bound vessels.

Canals.—The Coast Canal, from Geonkhali, at the junction of the Rupnarayan and Hugli Rivers, runs to the Huldia and Rasulpur Rivers, and then to Kontai, and thence into the Balasore District; it is used for navigation.

Geology.—A low ridge in the northwest part is formed of micaean schists, but the plains there are covered with laterite rocks, which gradually give way, in the south and east, to the ordinary alluvium of the Ganges Delta.

Flora and fauna.—Some species of figs, as the pipal and the banyan, with red cotton and other trees, are found in the vicinity of the villages, where palmyra palms are also present. Aquatic plants cover ponds and ditches, and climbing creepers and various milk-weeds are found in waste places and on hedges.

Bears and deer are still common in the west, and leopards and hyenas are not uncommon; there are a few wild elephants and wolves, and an occasional tiger may be met with. Small game, including wild geese, ducks, ortolans, teal, and hares, is plentiful, and snakes are numerous.

Population.—The population numbered 2,789,114 in 1901, of which about 88 per cent were Hindus; Bengali is the principal language, but nearly 10 per cent of the population speak Oriya.

Products.—Abundant rice crops are grown in the south and east, and other crops are wheat, barley, peas, linseed, mustard, sesamum, sugar cane, mulberry, jute, cotton, and indigo. Cattle are poor, and buffaloes are commonly kept for milk in the south. Jungle products are lac, tasar silk, wax, wood dye, bark fabrics, resin, firewood, and charcoal.

Excellent mats are manufactured; pottery is made, as also brass, copper, and bell-metal ware.

Trade.—The chief exports are rice, sugar, molasses, jute, linseed, gram, pulses, charcoal, brass and metal ware, timber, hides, mats, silk and cotton cloth, tasar silk, pottery, and vegetables. The imports are cotton goods, coal and coke, kerosene, gunny bags, salt, tobacco, potatoes, nails, etc.

Communication—Steamships.—The principal lines which have a regular service to Calcutta are the Peninsular & Oriental, British India, and Messageries Maritimes, but steamers of several other com-

panies visit the port regularly, and there are a number of lines of coasting and river steamers.

Railways.—The main line of the Bengal-Nagpur Railway, from Bombay to Calcutta, traverses the district from west to east, with branches to the south and north, at Kharakpur.

Climate.—The climate differs between the arid north and west and the swampy south and east portions, but the average mean temperature for the whole district is 80° , it being wetter and cooler near the coast line. In the north and west exceptionally high day temperatures are experienced in the hot months, and the mean maximum rises to 102° in April and May. The total rainfall averages 59 inches, of which 49 inches falls from June to October, both months inclusive.

The district is fairly healthy, with malaria in some of the low-lying tracts and in its center; cholera has considerably diminished, hepatitis is common, and elephantiasis exists in the swampy parts.

Sundarbans is the name given to a vast tract of forest and swamp extending for about 170 miles from the estuary of the Hugli to that of the Meghna, and stretching inland to distances of from 60 to 80 miles; it lies between the parallels of $21^{\circ} 31'$ and $22^{\circ} 38'$ north and the meridians of $88^{\circ} 5'$ and $90^{\circ} 28'$ east, has an area of 6,526 square miles, and includes the districts of twenty-four Parganas, Khulna, and Backergunge, the latter in Eastern Bengal.

Originally Mohammedan, in the fifteenth century, the Sundarbans are believed to have been more extensively populated, but it is supposed that piracy was the cause of depopulation.

Rivers.—Forming the lower part of the Ganges Delta, it is intersected from north to south by the estuaries of that river, the most important being the Hugli, Matla, Raimangal, Malancha, Haringhata, Rabnabad, and Meghna, which are connected with each other by an intricate series of branches, inclosing a large number of islands of various sizes and shapes.

Flora and fauna.—Mangroves, which almost entirely cover that part near the sea, gradually get thinner inland, and toward the north there are forests, in which the most plentiful and important species is sundri, with rather dense undergrowth; forests also cover the flat, swampy islands.

Tigers are destructive; the rhinoceros is nearly extinct; buffaloes, hogs, spotted deer, barking deer, and hog deer are found. The rivers are infested with crocodiles, dangerous to man and beast, and the cobra, the python, and many varieties of snakes are met with. In the cold season wild gees, ducks, and other birds are numerous on the sandbanks.

Population.—The population is somewhat floating, as between the months of October and May crowds of woodcutters come for the

purpose of cutting jungle. There are no towns or villages, and the inhabitants are scattered in small hamlets.

Products.—Rice is grown on reclaimed land in the north, and sugar cane and areca nuts are cultivated; country knives, buffalo-horn combs, and pottery are made.

Trade.—Rice, betel nuts, and black-clay pottery are exported.

Ports.—Canning, on the Matla River, is the only port.

Communication—Steamships.—A system of artificial canals connects the tidal creeks and channels of the Sundarbans, and regular lines of steamers use these, while country boats have access to almost every part.

Railways.—Canning is connected with Calcutta by rail.

Radio station.—Fraserganj, at the mouth of the Hugli, has been selected as a permanent radio station.

Climate.—The average rainfall varies from about 82 inches in the west to 200 inches in the east, and cyclones and storm waves occur from time to time.

Eastern Bengal.—Chittagong, the southernmost district of Eastern Bengal, lying between the parallels of 20° 35' and 22° 59' north and the meridians of 91° 27' and 92° 22' east, has an area of 2,492 square miles, and a seacoast of 166 miles, from the Fenny River to St. Martins Island.

Prior to its conquest by the Mohammedans, in the fourteenth century, it frequently changed hands, and from the sixteenth century the Portuguese had a great interest in the district. From 1686 to 1689 British expeditions were sent against it, and in 1760 it was ceded to the East India Co. In 1786 the French endeavored to establish a claim to certain parts. During the Indian Mutiny a native regiment at Chittagong joined the mutineers, and later the hill tribes gave trouble, but since 1892 the district has been quiet.

Physical features.—The district consists of a long, narrow strip of coast, with three low ranges of hills, parallel to each other and the coast, with valleys between.

Rivers.—The Fenny, which forms the western boundary, is only navigable for large boats for a distance of about 30 miles.

The Karnaphuli, the most important river, has a west and south-west direction, and enters the bay 10½ miles from the town of Chittagong, for which distance it is navigable for seagoing vessels, and for light-draft steamers as far as Rangamati; native cargo boats can go to Kasalang, 96 miles from its mouth, and during the rains river steamers can ascend to Barkal Rapids, 14 miles higher.

The Sangu River, which enters the bay about 10 miles south of the Karnaphuli, has a course of 168 miles; it is tidal as far as Bandarban, and is navigable for large cargo boats for a distance of 30 miles throughout the year.

The Mamori (Matamuhari) has a course of 96 miles, and discharges through a broad delta, somewhat resembling the Sundarbans, to the eastward of Kutubdia Island; it is navigable, through its extensive delta, for the largest boats.

Geology.—The district appears to consist of a substratum of Tertiary rocks, covered to a considerable extent by alluvial deposits, the hills being generally capped with laterite.

Flora and fauna.—The forests contain valuable timber, and what is known as Chittagong wood or Indian mahogany, besides species of oak, elm, and a chestnut, are found amongst several kinds of handsome trees. Canes and bamboos are luxuriant; ferns and orchids grow everywhere, and the vegetation is that of a moist tropical climate.

Tigers, black and clouded leopards, are found; bears are rare; elephants are destructive in the southern part; and wild cattle do damage to crops. Amongst other mammals are monkeys, the Indian fox, the jackal, the hog badger, the marten, the otter, and the scaly ant eater and squirrels; rats and mice are numerous.

The birds include vultures, falcons, eagles, hawks, kites, owls, swallows, and swifts. There are hornbills, broadbills, many varieties of flycatchers, pheasants, jungle fowl, geese, ducks, teal, and other birds too numerous to mention. All sea snakes are venomous, and of land snakes are the great hamadryad, the python, and green rattle-snake, but cobras are not common. Fish are especially numerous, and the best eating species is named rupchanda.

Population.—In 1901 the population was 1,353,250.

Products.—Rice is the most important crop, and hemp, tobacco, mustard, lentils, melons, and vegetables are grown; oil seeds, chillies, sugar cane, and betel are also cultivated.

Cattle are very poor; buffaloes are the most valuable domestic animals, and ponies and sheep are reared in small numbers.

Boatbuilding, weaving, and some metal work are carried on, and there are two small pearl fisheries.

Trade.—Tea, jute, and rice are the principal exports, and the chief imports are corrugated iron, salt, cotton piece goods, sugar, and oil.

Ports.—The ports are Chittagong, Cox's Bazar, and Nhila, the latter only used for the shipment of rice.

Communication—Steamships.—There are services of coasting steamers belonging to the British India Steam Navigation Co. and the Asiatic Steam Navigation Co., and the Bengal Steam Navigation Co. has recently started steamers between Chittagong and Burmese ports.

Two steamers run between Chittagong and Cox's Bazar; a weekly steamer plys to Rangamati, and a regular steamer service exists between Chittagong and Noakhali and Barisal.

Railways.—The Assam-Bengal Railway crosses the Fenny River from Noakhali, and runs for nearly 50 miles through the district to Chittagong, which is the terminus.

Canals.—The Boalkhali Canal connects the Karnaphuli and Sangu Rivers; the Banskali Canal joins the Sangu River to the Kutubdia Channel, and the Murari Canal, between the river of the same name and the Sikalbhanga River, shortens the journey from Chittagong to the Sangu River.

There are 541 miles of roads, all unmetaled.

Climate.—The district, forming a comparatively narrow belt lying along the sea coast, is favorably situated for both land and sea breezes, and the uniformity of temperature is more marked than in other parts of India; the climate is therefore moist, warm, and equable. The average maximum temperature is about 87° in December and January, and 98.7° in June, while the minimum is 45.4° in January, and 69.8° in August; during the monsoon season the mean temperature varies from 80° to 82° . The highest temperature registered in Chittagong is 101° , and the minimum 45° .

The average rainfall for the whole district is 111 inches, but it varies considerably from place to place, as at Cox's Bazar it is 140 inches, at Chittagong 105 inches, and at Kodala 96 inches. The humidity is lowest in January and February, and does not reach its maximum till September; during the whole monsoon season it varies from 80 to 91 per cent.

Owing to the number of waterways connecting the tidal river, and the innumerable tanks, neither of which are clean, and form breeding places for mosquitoes, malarial fever is very prevalent, and cholera occasionally breaks out in a virulent epidemic form; the other most prevalent diseases are those of the skin and ear and intestinal worms.

Burma, which stretches along the western edge of that portion of the continent of Asia lying between the Bay of Bengal and the China Sea, and generally known as Indo-China, is situated between the parallels of $9^{\circ} 58'$ and $27^{\circ} 20'$ north, and the meridians of $92^{\circ} 11'$ and $101^{\circ} 9'$ east, and has an area of 230,839 square miles; it is the largest Province of the Indian Empire.

Prior to 1852 British dominion was represented by the Provinces of Arakan and Tenasserim, but in that year the southern portions of the main central section were added, and 34 years after Upper Burma was annexed. In this work it is only necessary to mention those divisions which border the seacoast, which are Arakan, Irrawaddy, Pegu, and Tenasserim.

Arakan Yoma, or Yoma Mountains, the most southerly spur thrown out from the mass of hill country, stretching north and south along the western edge of Burma, is a well-defined narrow ridge, from 4,000 to 5,000 feet at its highest point, steep, and thickly wooded. There are two principal passes over the ridge, one from An, in the Kyaukpyu, and the other from Taungup, in the Sando-way District; the inhabitants of the Yomas are almost exclusively Chinese.

Time.—Standard time of the meridian of $97^{\circ} 30' 0''$ east, or 6h. 30m. 0s. fast of Greenwich mean time, is kept.

Akyab, the northern coast district of Arakan Division, which joins Chittagong on its northwest side, lies between the parallels of $19^{\circ} 47'$ and $21^{\circ} 27'$ north, and the meridians of $92^{\circ} 11'$ and $93^{\circ} 58'$ east, and has an area of 5,136 square miles.

It formed part of the kingdom of Arakan, and became a British possession in 1826, at the termination of the Burmese war.

Physical features.—A level tract lies between the sea and the Yoma Mountains, with broken country formed by the western spurs of that range, and valleys which cover the portion east of the Lemro River. The northern part is also covered with hills, and in the west, between the Naaf and Mayu Rivers, is the steep Mayu Range, terminating near the mouth of the river of that name; two similar ranges are also parallel to the coast, about 30 miles from Akyab Town.

Rivers.—The rivers generally flow from north to south, and the principal are the Mayu, the Kaladan, and the Lemro, which at first are only mountain torrents, but in the plains spread out into a network of tidal channels.

The Kaladan is the largest and most important of these, and receives a large number of tributaries in its course, which is nearly due south through the Akyab District, to its estuary at Akyab Town, where it is 6 miles broad and forms the harbor.

Geology.—Beyond the alluvium, which skirts the coast, the district contains Cretaceous, Low Tertiary, and Triassic beds, closely allied, and composed of sandstones and shales, interspersed by bands of limestone.

Flora and fauna.—The coasts and tidal creeks are bordered by mangroves and dani palms, and, in addition to the trees of the tidal forests, the forest trees include kabaung, pyingado, thitkado, and thitka, but there are no teak trees. Further eastward the Arakan hills are covered with dense forest and bamboo jungle, at present unexplored by botanists.

Elephants, bison, tigers, and leopards are the most important wild animals; sambar are plentiful on the hillsides, and hogdeer in the low-lying jungle; wild hogs abound, and the jackal is found everywhere.

Population.—In 1901 the population was 481,666, of which about two-thirds were Buddhists and one-third Mussulmen.

Products.—Rice is the principal crop, chillies, mustard, and the dani palm for thatching are also grown; cotton, tobacco, sugar cane, and flax are cultivated in small quantities. A superior breed of buffaloes are raised, goats are reared in numbers, but sheep are not bred.

Coal of an inferior quality has been found, and gold and silver are said to exist. Oil wells are worked on Baronga Island.

The chief industries are cotton and silk weaving, gold and silver work, carpentry, shoemaking, pottery, and ironwork.

Ports.—Akyab is the principal port.

Communication—Steamships.—The British India Co.'s vessels call weekly at Akyab for Kyaukpyu, Sandoway (in the fine season), and Rangoon, and weekly for Chittagong and Calcutta. River steamers belonging to the Arakan Flotilla Co. ply on all that part of the Kaladan River that lies within the district and through the tidal creeks.

There are only 200 miles of roads, and of these only 40 miles are metaled; except in and near Akyab Town, there is practically no vehicular traffic.

Climate.—Owing to the proximity of the sea, extremes of heat and cold are not experienced, and the cold season, from December to February, is the pleasantest, the hot season being oppressive and the wet season very trying. The average maximum temperature for the whole year is 86°, the average minimum 74°, and the average mean 78°.

The rainfall in 1903-4 was 180 inches, varying from 173 inches at Maungdaw to 203 inches at Akyab.

Kyaukpyu, the next district southeastward of Akyab, lies between the parallels of 18° 40' and 20° 40' north and the meridians of 93° 13' and 94° 26' east, and has an area of 4,387 square miles. Previous to the conquest of Arakan by the Burmans in the eighteenth century, Kyaukpyu belonged to the Arakan Kingdom, and for 30 years after the cession to the British, Ramree and Cheduba Islands formed a separate district, afterwards becoming a part of Kyaukpyu.

Physical features.—It includes a strip of mainland extending from the western slopes of the Yoma Mountains as far south as the Myhi (Mai) River, and, besides Ramree and Cheduba Islands, a small archipelago of lesser islets lying along the coast and separated from it by a number of tidal creeks and Hunters and Combermere Bays.

Geology.—The rocks are partly Cretaceous and partly Eocene, and a particular feature of the Arakan coast is the number of mud vol-

canoes which occur, often taking the form of conical hillocks, discharging marsh gas and sometimes flames.

Rivers.—There are no rivers of any importance; the Dalet and An are navigable for boats for distances for 25 and 45 miles, respectively, from their mouths, but above that are mountain torrents.

Flora and fauna.—Pyingado is the most valuable timber tree, forming compact masses of forest along the lower hills and the adjoining plains, and also on the hills of Ramree Island, where thitya, pyinma, and shawta also grow; kanyinbyu, kokko, and pyinma are much used for boat building.

The forests abound with tigers, bears, deer, and wild hogs, and there are wild elephants in the mountains.

Population.—In 1901 the population was 168,827, principally Arakanese and Burmese, these also being the languages generally spoken.

Products.—Rice, sugar cane, and tobacco are cultivated, and the dani palm is grown for thatching; a number of acres are under garden cultivation. Buffaloes, cattle, and a few goats are bred.

Two companies are extracting petroleum oil, of which more than 100,000 gallons are produced annually. Limestone is extracted from the hills, and coal has been found, but not worked, in both Ramree and Cheduba Islands; there is also unworked iron in the former island. Salt is manufactured by evaporation. Mat weaving and pottery are the only other manufactures.

Trade.—The exports are rice, salt, timber, fish maws, hides, and horns, and the chief imports are hardware, foodstuffs, cloth, waist-coats, cotton, and silk.

Ports.—The principal port is Kyaukpyu Harbor, which is a large area of water extending for 30 miles between Ramree Island and the mainland.

Communication—Steamships.—Steamers of the British India Co. call weekly at Kyaukpyu, in both directions, giving communication with Akyab, Sandoway, and Rangoon. Subsidized launches maintain weekly services to the headquarters of the townships, and run also to Akyab and Sandoway.

Telegraph.—There is telegraphic communication.

Climate.—The climate is notoriously unhealthy; malarial fevers and bowel complaints are prevalent, the former at the beginning and the latter at the end of the rains, and the town itself is said to be situated in a very unhealthy area. The temperature varies little throughout the year, averaging 84° in 1900, when the maximum, registered in June, was 97°, and the minimum, in January, was 74°.

The rains, lasting from May to October, are heaviest in July, August, and September, and the annual rainfall for the years 1902–1904

averaged 182 inches, being greatest at Ramree (203 inches) and least at An (161 inches).

Sandoway, the district which adjoins Kyaukpyu on its southeast side, is a narrow strip, 179 miles in length and 48 miles in extreme breadth; it lies between the parallels of $17^{\circ} 15'$ and $19^{\circ} 32'$ north and the meridians of $94^{\circ} 0'$ and $94^{\circ} 52'$ east, and has an area of 3,784 square miles.

Supposed at one time to have been the capital of the Arakan Kingdom, it was afterwards only a province till the conquest of Burma in 1784, when it became a governorship. It was ceded by treaty to Britain in 1826.

Physical features.—It is mountainous, the spurs of the Yoma Mountains reaching almost to the coast, leaving not more than one-eighteenth of its area level. In the plains, and except where there are clearings on the hillsides, it is covered with dense jungle. In the northern part of some of the peaks of the Yoma Mountains attain an elevation of about 5,000 feet, but lower to the southward, and abreast the Gwa River, the height is about 900 feet. Foul Island, a mud volcano, which pours out mud and marsh gas and lies off the coast, was in eruption in 1908.

Rivers.—Most of the rivers are but mountain torrents. The most important are the Myhi (Mai) and the Tanlwe, which fall into the arm of the sea dividing Ramree Island from the mainland.

The Taungup enters near the village of that name, and the Sandoway, about 18 miles farther south, is tidal and navigable for boats as far as Sandoway Town; the Gwa discharges about 60 miles southward of the Sandoway.

Geology.—The rocks of the district are mostly Cretaceous, those of the Myhi River being composed of limestones, shales, and grayish-green sandstone; the remainder are of the Eocene Age.

Flora and fauna.—The lowest ground, within tidal influence, is covered with mangroves, but almost the whole of the remainder is clothed with forest, the trees varying with the altitude of the land. The most important are pyingado, in, pyinma, kanyinbyu, thingau, zinbyun, and the myaukchaw; various kinds of palms are common, especially the dani.

The fauna is varied, including elephants, tigers, leopards, wild cats, bears, wild hogs, deer, and monkeys. Jackals are common, as are crocodiles; the rhinoceros is found, and game birds are plentiful.

Population.—In 1901 the population was 90,927, of which 87 per cent were Buddhists; Burmese and Arakanese are the languages spoken.

Products.—Rice, tobacco, and sesamum are grown in the low ground, and in the hill clearings sugar cane, plantains, and cotton;

the garden cultivation consists of mangoes, pineapples, and jacks of inferior quality.

Cattle are raised, but ponies are scarce; coal has been reported in the vicinity of Sandoway Town, but is probably of inferior quality. Silk and cotton weaving are common; there are sugar mills and a steam sawmill near Sandoway.

Trade.—The principal exports are salted fish, fish paste, rice, timber, cattle, horns, hides, tamarinds, chillies, jaggery, and coconuts; and imports, cotton twist, silk, and other apparel, oils and iron; tobacco and betel nuts are also imported.

Ports.—The principal anchorages are off the mouth of the Sandoway River from which the town is distant 15 miles, and at Gwa.

Communication—Steamships.—Steamers of the British India Co. call at the mouth of the Sandoway River every week, but only small steamers of about 20 tons can ascend to the town. There are only about 20 miles of metalled roads, the remainder being merely foot tracks.

Climate.—The climate is considered to be more pleasant and healthy than other parts of Arakan, the year being divided into the cold season, from November to February, the hot season, from February to May, and the wet season, from May to October, the mean monthly temperature being 90° in June and 72° in January. The rainfall is very heavy, and during the three years ending 1904 it averaged 189 inches over the district, being 158 inches at Gwa, 201 inches at Taungup, and 198 inches at Sandoway; July is the wettest month.

Bassein, a district of the Irrawaddy division of Burma, forming an irregular wedge-shaped strip of land and delta, narrowing from north to south, lies between the parallels of 15° 50' and 17° 30' north and the meridians of 94° 11' and 95° 28' east, and has an area of 4,127 square miles.

The port of Bassein has long been of trading importance, and in 1687, after unsuccessfully attempting settlement on the Irrawaddy Delta, the East India Co. occupied Negrais (now known as Haingyi) Island, and in 1757 obtained land at Bassein, but in 1759 the settlers were nearly all murdered. Bassein was held as a pledge by the British in 1824, during the first Burmese war, and in the second war, in 1852, was finally occupied.

Physical features.—The Yoma Mountains, entering the district at its northwest corner, and stretching down its western side at no great distance from the sea, divide it into two unequal parts, the main portion, a flat alluvial plain, being on the eastern side.

Rivers.—The whole country is intersected by tidal channels, mostly unimportant, the principal river being the Bassein, which, branching off the Irrawaddy above Henzada, runs almost due south

through the district and enters the sea at Negrais by two mouths, the eastern silted up. The western branch is navigable for vessels of 27 feet draft, and leads to Bassein Town.

Inye Lake, in the northeastern part, is 7 miles in circumference, and averages 15 feet in depth in the dry season.

Geology.—North of Bassein Town are considerable beds of laterite, and on the west coast a remarkable patch of calcareous sandstone occurs; the Eocene group of rocks is well developed, which in the south are termed the Negrais Beds. Near Ywatpa is a mud volcano, supposed to be connected with others in Arakan.

Flora and fauna.—The main varieties of timber trees are found, and inland are evergreen forests, while large areas of mangroves grow near the rivers, and palms of various kinds are common.

Tigers are scarce, but elephants, sambar, bison, leopards, and bears are fairly common; the rhinoceros is nearly extinct. Crocodiles are found in the tidal creeks, and there are rich turtle beds on the coast near the south.

Population.—In 1901 the population was 391,427, chiefly Buddhists, the languages spoken being Burmese and Karen.

Products.—About one-fifth of the whole area is under rice, and tobacco and dani palm are cultivated; there is also some garden cultivation. Cattle are raised, but disease is rife.

The fisheries are valuable, those of Inye Lake being the most important, both loggerhead and green turtle are plentiful on the southern coast; the only minerals are pottery clay, laterite, limestone, and sandstone.

The hand industries are pot making and umbrella manufacture. There are several rice and saw mills.

Trade.—The maritime export trade is practically confined to rice, and the imports are piece goods and hardware.

Ports.—Bassein is the principal port.

Communication—Steamships.—No seagoing lines of steamers call at Bassein, but the Irrawaddy Flotilla Co. run steamers from Bassein three times every week to Rangoon, via Myaungmya, Wakema, and Ma-ubin, and to Kyonpyaw; also daily steamers to Myaungmya, and twice weekly to Ngathainggyaung, and in the rains to Henzada. Scarcely any village of size eastward of the Yoma Mountains but has communication by small steamers.

Railways.—The Bassein-Henzada-Letpadan Railway runs from Bassein Town for 66 miles through the district.

The roads are chiefly in the vicinity of Bassein Town, as in the south all communication is by water.

Climate.—The climate is rather relaxing, though the strong sea breezes, which spring up in the afternoons, temper the summer heat.

The mean maximum temperature is about 95° in the hottest months, and the minimum about 75°.

The rainfall is heavy, the annual average for the district during the 10 years ending 1904 was 113 inches, the lowest fall being at Kyonpyaw, where it was 88 inches.

Myaungmya, the delta district, lying immediately eastward of Bassein, and between the parallels of 15° 44' and 16° 55' north, and the meridians of 94° 36' and 95° 35' east, has an area of 2,663 square miles. The district is of modern formation, and has no particular history.

Physical features.—It consists of a number of flat, fertile islands, separated by rivers or tidal creeks, mostly navigable, and, with the exception of a small tract of rising ground, about 30 miles southward of Myaungmya Town, the general surface is little above the rise of spring tides. Near the coast stretches of mangrove jungle and dani palms border the mud creeks, while farther north are plantain groves and pagodas, otherwise it would present but a waste of wide rice flats, checkered with strips of grass and tree jungle.

Rivers.—The waterways, all branches of the Irrawaddy, are the main natural features; on the western side it is skirted by the Panmawaddy, which flows into Bassein, but leaving a branch, the Thetkethaung, still bordering it.

The Pyamalaw, running down the center of the district, enters the sea by two mouths, named the Pyamalaw and the Pyinzala. The Irrawaddy, forming the eastern boundary for 24 miles, divides and forms two branches, the western named the Yazudaing, and between this and the Pyinzala is the Shwelaung, which, after flowing for 25 miles, joins a branch of the Irrawaddy, and becomes the Kyunpythatt, joining the Irrawaddy 24 miles from the sea. There are other smaller rivers.

Geology.—The soil is composed of alluvial formation, resting on a substratum of black clay, but in the hilly tract are rocks of the Eocene group.

Flora and fauna.—Tidal and swamp vegetation predominate, and the flora is of the type common to river deltas.

Elephants and tigers are found in the southern and unreclaimed parts, and leopards everywhere; sambar and barking deer are fairly plentiful in some places, and monkeys abound in the southern forests, while crocodiles infest the smaller creeks; turtle and tortoises are common on the seacoast.

Population.—The total population in 1901 was 278,119, about two-thirds being Burmans and one-third Karens, and both Burmese and Karen are spoken.

Products.—Rice is principally grown, but there are plantain groves, and the dani palm, sugar cane, and sesamum are also culti-

vated. Buffalos and cattle are bred, and turtle banks exist along the coast. Pottery constitutes the only domestic occupation, and salt and fish paste the only manufactures.

Trade.—Rice and fish paste are the chief exports, and the imports comprise piece goods, hardware, kerosene oil, etc.

Ports.—The ports, or rather stopping places of the steamers within the district, are Myaungmya, Wakema, and Shwelaung.

Communication—Steamships.—The main steamer route from Rangoon to Bassein traverses the district by the cross streams which connect the rivers, and the main trade centers are kept in regular communication with each other by services of small steamers and launches.

Railways.—A light railway to connect Myaungmya with Pantanaw, in the Ma-ubin district, is contemplated.

Climate.—Although enervating, the climate is not altogether unhealthy, and its proximity to the sea makes it more equable than farther inland. The average maximum temperature is about 95°, and the thermometer never rises above 105°; the average minimum is about 65°, the average mean being 80°.

The rainfall is heavy and regular, varying locally, being from 90 to 130 inches in the southern, and from 70 to 90 inches in the northern parts.

Pyapon, the delta district which forms the eastern boundary of Myaungmya, is in the shape of a truncated triangle, the sides of which are the Irrawaddy, on the west, and the China Bakir River on the east, the base being the seacoast; it lies between the parallels of 15° 40' and 16° 41' north, and the meridians of 95° 6' and 96° 6' east, and has an area of 2,137 square miles.

As in the case of Myaungmya, it is of recent formation, having been a stretch of unreclaimed jungle until recent years.

Physical features.—It consists of a vast plain, intersected by tidal creeks and waterways, and, with the exception of very small areas, named kondans, which are narrow strips of land from 4 to 10 feet above the level of the plain, it is subject to inundation at high water, spring tides.

Rivers.—The rivers, which are the southeastern portion of the network forming the outlet of the Irrawaddy, are all tidal, and that river, which, with one exception, is the boundary between this district and Myaungmya, is navigable for river craft at all seasons of the year.

The China Bakir River forms the eastern boundary, and its western mouth is known as the Pyapon, and between it and the Irrawaddy the Byondon runs into the sea near Pyindaye, the lower reaches of this river being separated from the Irrawaddy by two large islands covered with fuel reserves.

Geology, etc.—The geology, flora, and fauna are practically the same as given for Myaungmya.

Population.—In 1901 the population was 226,443, of which 88 per cent are Burmans and Karens, in the northern portions; Burmese and Karen are spoken.

Products.—Rice is principally grown, and near river banks there is garden cultivation, the dani palm, betel nuts, and coconuts being cultivated. Domestic animals are not bred in any numbers. The fisheries are valuable, the most important inland being an area in the north, inclosed by three rivers; turtle beds along the coast yield large numbers of eggs annually; fish paste and rice milling are the only manufactures.

Trade.—The principal exports are rice, fish paste, horns, hides, and firewood, and imports, silk and cotton goods, kerosene oil, sugar, salt, jaggery, pickled tea, areca nuts, hardware, and cutlery crockery.

Ports.—Pyapon, Kyaiklat, and Dedaye are the principal towns where steamers call.

Communication—Steamships.—The Irrawaddy Flotilla Co. maintain an extensive service of steamers; launches plying daily between Pyapon and Rangoon, calling at Kyaiklat and Dedaye, and by-weekly steamers run from Moulmeingyun, in the Myaungmya district, via Bogale, Pyapon, Kyaiklat, and Dedaye, calling at Pyindaye in the dry season.

Climate.—The climate, although damp and depressing, is healthy, the proximity of the sea rendering it equable. The average maximum temperature is about 95°, the average minimum 65°, and the average mean 80°.

The rainfall is heavy and regular, the average annual fall being about 95 inches, decreasing toward the north.

Hanthawaddy, a district of the Pegu division of Burma, which lies on the eastern side of Pyapon, and between the parallels of 16° 19' and 17° 47' north, and the meridians of 95° 45' and 96° 45' east, has an area of 3,023 square miles. In the center, and completely surrounded by it, is the separate district of Rangoon; and the Cocos and Preparis Islands form a part of it.

It originally formed part of the Talaing Kingdom, and, with the rest of Pegu, came under British rule at the close of the second Burmese war. In 1879 it was separated from Rangoon; in 1883 it was split in two; in 1895 its limits were enlarged by the addition of Kyauktan; and in 1903 the last revision of boundaries was made.

Physical features.—It is a vast deltaic plain, broken only by the spurs of the Pegu Yoma, which separate its northern part from Pegu; these mountains attain a height of 2,000 feet. The seacoast is low, showing large stretches of mud at low water, and inland, except in the vicinity of Rangoon, the land consists of rice cultivation

and swamp, relieved by scrub jungle, with numerous waterways near the sea.

Rivers.—The main stream is the Hlaing, which, entering the district near its northern end, flows southward through it and is navigable throughout the district by native craft. The Rangoon River, which, as the Pegu, joins the Hlaing near Rangoon, flows southward into the Gulf of Martaban.

Geology.—The plains are composed of homogeneous post-Tertiary alluvium, resting on a bed of water-worn gravel; the Pegu Yoma is skirted by a broad bed of sandy deposit, and laterite is found on many of the lower hills.

Flora and fauna.—The coast line is fringed with dense low mangrove jungle, covered regularly by the tide, beyond which are tidal forests from 40 to 50 feet high. Nipas and pandanus form dense bushes, and creepers and climbers abound, while behind this are either open evergreen tropical or low deciduous forests.

Elephants, bison, and various kind of deer are common in the mountains, the rhinoceros is rare, but tigers and leopards are increasing; the fish-eating monkey and the short-nosed crocodile frequent the tidal creeks.

Population.—The total population in 1901 amounted to 484,811, the majority being Burmans, and others Karens, Talaings, and Shans. Burmese is the ordinary language, but Tamil and Telugu are also spoken.

Products.—Rice is the only crop of importance, but fruit and vegetable gardens, growing pineapples, mangoes, jack fruit, marian plums, betel nuts, and other fruit and vegetables may be noticed. Cattle and buffaloes are bred, and laterite and pottery clay are produced.

Cotton weaving is carried on, salt and fish paste are manufactured, and coarse mats woven. There are rice mills, saw mills, and an oil refinery. The fisheries, mostly in the western part of the district, are valuable.

Trade.—With the exception of teak and other forest produce, rice composes the entire export, and the principal imports consist of piece goods, salt, oil, sugar, hardware, oilman's stores, gunny bags, rope, and miscellaneous goods.

Ports.—Rangoon is the principal center for steamers.

Communication—Steamships.—The Irrawaddy Flotilla Co. has daily service of steamers from Rangoon to Thongwa, via Kyauktan, and from Rangoon to Twante through the canal. From Rangoon, launches run daily down the Rangoon River to Kungyangon Villages, and up the Pegu River to Kamamat, and a regular service is maintained on the Hlaing River; a steam ferry plies between Rangoon

and Syriam, and boat ferries are on all the chief lines of communication.

Railways.—The Rangoon-Prone Railway runs from south to north for 60 miles through the district, and the Rangoon-Mandalay Line runs northeastward.

Canals.—The Twante Canal provides the quickest route from Rangoon to the main stream of the Irrawaddy, and is much used by small river steamers and boats.

Climate.—The moist and depressing climate is not altogether unhealthy. The heat is oppressive from the middle of March till the rains break in May, and the nights the same from the end of the rains, in September and October; the days are often muggy and trying.

December and January are cool and pleasant, the average minimum temperature being 60°. In the southern part, where the air is cooled by the sea breeze, the maximum is from 83° to 95°, increasing farther north.

The rainy season lasts from May to October, with sometimes two or three days in spring, and the average annual rainfall is 94 inches at Insein, 98 inches at Rangoon, and 119 inches at Kyauktan.

Thaton, the district which occupies the seacoast stretching from the Sittang to the Gyaing Rivers, lies between the parallels of 16° 28' and 17° 51' north, and the meridians of 96° 30' and 98° 20' east has an area of 5,079 square miles.

It comprises the greater part of the ancient Talaing Kingdom, and was easily occupied by the British in the first Burmese war, in 1824, but was given up afterwards, and again occupied during the second Burmese war, at the end of which it was taken over by Britain.

Physical features.—It is intersected by three main groups; the Dawna Range, in the east and northeast parts, varies in height from 1,000 to 5,500 feet; the Taungmyo Range, separated from the Dawna by a plain some 50 or 80 miles wide, separates the Ataran Valley, in Amherst District, from the seaboard townships, and continues in the Martaban Hills, which, from Moulmein, run north and northwest into the Salween District.

In the northwest part of the district, between this last range and the Sittang Estuary, is a limestone range entering from the north, the western spur of which, known as the Kelatha Hills, rises to a height of 3,650 feet opposite Sittang Village.

Rivers.—The Sittang, for the last 40 miles of its course, forms the western boundary. The Bilin, which enters the district from Salween and flows between the Martaban and Bilin Hills, has a course of 280 miles, and discharges into the Gulf of Martaban.

The Salween River, entering the northern corner of the district, has a southerly course, and divides it, roughly, in half; it flows into

the sea at Moulmein, where it is divided into two mouths by Bilugyun Island.

The Hlaingbwe and Haungtharaw Rivers combine about 45 miles from the sea, and, under the name of Gyaing, form the southeastern border of the district.

Geology.—Very little is known of the geology; the hills are mostly of laterite or limestone, and the low-lying tract in the southwest part has at one time emerged from the sea.

Flora and fauna.—The flora is that ordinarily met with in the wet areas of Lower Burma.

A few wild elephants are found in the northwest and northeast parts, leopards abound, tigers are not numerous, but bears are common, and the barking deer and hog deer are plentiful in places. The scarcity of wild fowl is remarkable.

Population.—In 1901 the population was 343,510, Karens being the most numerous; Burmese, Karen, Talaing, and Taungthu are the languages spoken.

Products.—Rice is the main crop, and garden cultivation is of various kinds; sugar canes, plantains, durians, and areca palms are grown. Cattle breeding is extensively practiced, and buffaloes and goats are reared to a small extent. There are 72 fisheries, and fishing and fish curing occupy a number of inhabitants; manufactures may be considered as nonexistent.

Trade.—Rice is principally exported, and other exports are teak, firewood, and lime; the chief imports are cattle.

Ports.—Martaban is the chief port.

Communication—Steamships.—Steam launches run from Moulmein up some of the rivers, and a navigable canal, 13½ miles long, connects Sittang River with Kyaikto, which is served by a steam launch.

Railways.—A light railway, 8 miles long, runs from Thaton Town to Duyinzeik.

A railway from Pegu to Martaban is in course of construction.

Climate.—The climate, moist and oppressive, is generally salubrious, shows no extremes of temperature, and, near the sea, enjoys a cool breeze. The average mean temperature for the following months, registered during the decade ending 1901, was 74° in January, 84° in April, 77° in July, and 82° in October.

The rains are heavier in this district than in any other part of Burma, except, perhaps, Tavoy and Sandoway; the average rainfall for six years ending 1901 was 201 inches at Thaton and 196 at Bilin.

Amherst, the district lying to the southward of Thaton, and between the parallels of 14° 56' and 17° 2' north, and the meridians of 97° 27' and 98° 51' east, is in the Tenasserim Division of Burma, and

has an area of 7,062 square miles. Originally Siamese territory, it was conquered by the Burmese in 1760 and became a British possession in 1826.

Physical features.—It consists for the most part of alluvial plain, shut in on the west by the low Taungnyo Range, running parallel to the coast, and on the east by the Dawna Hills, and in the extreme east is a narrow, densely wooded region. The highest part of the Dawna Range is 5,500 feet, and this range throws out numerous spurs and extends southeastward for about 200 miles.

Rivers.—The chief rivers are the Salween, the Gyaing, the Ataran, and the Thaungyin.

The Salween enters the sea about 28 miles south of Moulmein, where it is a broad, shallow waterway obstructed by shoals, preventing the entry of seagoing vessels, except at its southern mouth; for hundreds of miles from its source it is swift, narrow, and turbulent.

The Gyaing, already mentioned, has islands and sand banks choking it, but is navigable for native boats and launches all the year around.

The Ataran, formed by the junction of the Zami and Winyaw Streams, in the southern part of the district, is narrow, deep, and sluggish, and runs in parts between high banks, with dense overhanging foliage.

The Thaungyin rises in the Dawna Hills, joins the Salween after a course of about 200 miles, and has breadths of from 100 to 1,000 feet, but is unnavigable on account of rapids.

Geology.—The Moulmein group of rocks, consisting of hard sandstone, gray shaly beds, fine soft sandstone, and hard thick limestone, are well developed; they rise precipitously from the plain around Moulmein, and are one of the chief features. Hot springs occur in several parts, the largest near Ataran Village, which spring has a temperature of 130° F. Lead ore has been found.

Flora and fauna.—There is excellent timber, and the dani palm and bamboo abound, while fruit trees are exceptionally plentiful; orchids are common in the hills.

The principal animals are the tiger, the leopard, the bison, and the hog; the rhinoceros is found in some parts, and the Malayan tapir is reported.

Population.—The population in 1901 numbered 300,173, five-sixths of whom were Buddhists; Talaing is the language most in use.

Products.—Rice is principally grown, and garden cultivation consists of areca and coconut palms, sugar canes, and plantains; there are also some rubber trees. Cattle and buffaloes are bred, and are plentiful; goats are also fairly numerous.

Some gold and silver work is produced, and ivory carving is a specialty; there are a number of saw and rice mills, a steam joinery, and a foundry.

Trade.—The chief exports are rice and timber, and imports vegetable oils, tobacco, gunny bags, betel nuts, sugar, spices, cotton twist and yarns, cotton, silk, and woolen piece goods, machinery, metals, and kerosene oil.

Ports.—Moulmein is the principal port.

Communication—Steamships.—Moulmein is connected with Rangoon by steamers running three times weekly, and there is a regular steamer service from Moulmein, passing down the Tenasserim Coast, calling at the port of Ye.

Steamboats also run between Moulmein and Kado, on the eastern bank of the Salween, and also to several points on the Gyaing, Haungtharaw, and Ataran Rivers.

A steam ferry will connect Moulmein with the railway under construction to Pegu.

Climate.—The coast and low-lying country are hot, and have no real cold season, but in the hills the temperature is quite low in winter and the nights are fairly cool in the plains, except for short periods in April and October. The mean maximum and minimum temperatures throughout the year at Moulmein are 89° and 73° respectively.

During the decade ending 1900 the rainfall at Moulmein averaged 188 inches, 213 at Amherst, and 166 at Kawkareik. From the beginning of November to April there is practically no rain.

Tavoy, the district lying next southward of Amherst and between the parallels of 13° 16' and 15° 6' north and the meridians of 97° 46' and 99° 12' east, has an area of 5,308 square miles. Its history is obscure, but it belonged at various times to Siam, Pegu, and Ava; in 1757 it was a province of Siam, in 1759 it became Burmese, and during the first Burmese war an expedition was sent against it by Britain; since 1829 it has remained in undisturbed British possession.

Physical features.—It consists of a rugged tract 150 miles long and 50 miles broad at its widest part, and, except for the Tavoy Basin and a narrow strip along the coast, is composed of hills. The ranges run generally north and south, one dividing the Tavoy River from the sea, a second forming the watershed between the Tavoy and Tenasserim Rivers, while the third is near the boundary between the district and Siam. The highest peak is Myinmoletkat, 6,800 feet high.

Rivers.—The Tenasserim, rising in Myinmoletkat Peak, flows north, then sharply turns east, and runs into Mergui District; in the dry season it is only navigable for canoes.

The Tavoy rises in the northern part of the district, flows south past Tavoy Town to the sea, and is navigable for light-draft steamers to Tavoy, and for 40 miles farther by boats.

The Moscos Islands, rocky and uninhabited, lie about 10 miles off the coast.

Geology.—The mountains appear to be granite, the intervening valleys having patches of clay slate. The coast hills contain an abundance of micaceous iron ore and clay ironstones, and near Tavoy is an elevated ironstone ridge; the plains are composed of stiff clay.

Flora and fauna.—Besides timber trees, the castor-oil plant, sarsaparilla, and the sea coconut grow, and there are several vegetable dyes.

The wild animals include elephants, tigers, leopards, hog deer, barking deer, Malay bears, hogs, monkeys, the rhinoceros, and the sambar; orang-outang is reported to be found in the hills. Birds include the peafowl, the pheasant, and the hornbill. Fish abound, crocodiles are numerous, and the sea beaches are frequented by turtle.

Population.—In 1901 the population was 109,979, of which 96 per cent were Buddhists, and the principal language is Burmese.

Products.—Rice is the chief product, and a large area is planted with fruit or palm trees, while on small areas cotton, hemp, cardamoms, tobacco, and coffee are grown. Cattle and buffaloes are largely bred, and goats to a small extent. Tin is worked, salt is manufactured, and Tavoy Town is noted for silk weaving.

Trade.—The chief exports are rice, salt, and timber, and precious stones are the principal import.

Ports.—Sinbyubyin, about 10 miles within the entrance to the Tavoy River, is the chief port.

Communication—Steamships.—The weekly steamer of the British India Co., running between Rangoon and Mergui, calls at Sinbyubyin, and passengers and cargo are transhipped to a steam launch, which ascends the river to Tavoy, 26 miles distant.

A steamer of the above company also connects the port with Moulmein fortnightly, and a coasting steamer, between Rangoon and Penang, every 18 days.

There are 185 miles of metaled and 74 unmetaled roads.

Climate.—Sea breezes moderate the intense heat in the hot season, and during the cold season the temperature in the shade is seldom 92°, falling in the early morning occasionally to 57°.

The rainfall is heavy, the average fall for three years ending 1904 being 228 inches, and at Launglon it has been known to reach 252 inches, the highest recorded in the Province.

Mergui, the southernmost district of Burma, extends from Myin-moletkat Peak, in the north, in latitude 13° 28' north, to the mouth of the Pakchan River, in 9° 58' north, and includes the islands of the

Mergui Archipelago, from Tavoy Island to Christie Island, which stretch westward to $97^{\circ} 30'$ east; the total area is 9,798 square miles.

The district, which has ever been a battle ground between the kingdoms of Burma and Siam, was at different times held by each of them, while in the seventeenth century it was in the hands of the French for a short period; at the end of the eighteenth century it belonged to Burma, but when war was declared, in 1824, it, with Arakan and Tenasserim, came under British rule.

Physical features.—In the northern part the Great Tenasserim Valley is separated from the sea by a mountain range, having Myinmoletkat Peak on the northern border, and between this range and the coast is a fertile plain watered by small streams. In other parts such level land as exists is mostly covered at high water by the sea, or inland, flooded during rains.

Rivers.—The principal rivers are the Great and Little Tenasserim, the Lenya, and the Pakchan.

The Great Tenasserim, rising in Tavoy, enters the district about 140 miles above Tenasserim Village, where it turns back on itself and flows into the sea; the Little Tenasserim, flowing northward, joins it at the village of the same name.

The Lenya, southwest of, and nearly parallel to, Little Tenasserim, after a bend to the northwest, runs direct to the sea.

The Pakchan, rising near the Lenya, flows south to Victoria Point, and from Pakchan downward forms the boundary with Siam.

Geology.—Coal is found in association with shales, sandstone, and conglomerates, which form a tertiary basin. The Mergui Group, sedimentary beds with embedded fragments of felspar, are under the Moulmein Group, which constitute the greater part of the sedimentary rocks. Rocks of the gneissic series, with granite in which there are tin ores, also occur.

Flora and fauna.—The flora resembles that of Tavoy, but there is a good deal of swamp vegetation; canes are abundant. Monkeys, especially the fisher monkey and the white-handed gibbon, swarm; elephants, tigers, barking deer, and hogs are plentiful, and the rhinoceros, the bison, and the sambar are found. The archipelago abounds with fish, prawns, and shrimps; pearls and other shellfish are found, and whales are frequently seen.

Population.—The population in 1901 numbered 88,744, mostly Burmans, with some Siamese and Chinese, and a wild people, known as Salons, live among the islands; Burmese, Siamese, Malay, and Chinese are spoken.

Products.—Rice, dani palms, areca palms, and durians are grown, and bufaloes are bred. About one-eighth of the population is engaged in fishing, and next to this is pearling in the archipelago;

green snails and bêche-de-mer are also maritime products. The edible birds' nests of the swift are found on the islands.

Tin is mined and smelted; gold exists in many places, but not so far in paying quantities, and coal of superior quality to the generality of Indian coal is said to exist in large quantity.

Trade.—Tin in blocks, pearls and shells, green snails, birds' nests, and bêche-de-mer are exported.

Ports.—Margui is the principal port, the others being Palaw and Victoria Point (Kansong).

Communication—Steamships.—The British India Co.'s weekly steamer from Rangoon calls at Mergui, and also the fortnightly one from Moulmein. A small Chinese steamer from Penang calls at Victoria Point and other small ports. Roads scarcely exist, owing to the water communication.

Climate.—The district is unusually healthy for a tropical climate, and malaria is little known. The mean maximum temperature at Mergui town is 93° in April and 85° in August, and the mean minimum 68° in December and 75° in April and May.

The rainfall during the five years ending 1901 was 103 inches.

Mergui Islands.—The Mergui Archipelago extends from about latitude 8° 30' north for a distance of about 300 miles, and consists of over 200 islands, covering an area of roughly 10,000 miles; probably the earliest detailed account of the islands is from a Capt. T. Forrest, who visited them in 1792. They were taken over from Burma by the British in 1826.

They are nearly all high, and on the larger ones the mountain ranges run north and south, parallel to the coast, the islands being in two parallel chains; the whole archipelago is within the 50-fathoms contour line. Dense jungle covers all the islands, coming down to the water's edge in the case of the more precipitous ones, while the lower islands are often fringed with mangroves; a conspicuous feature of the northern islands is the large number of blasted trees, said to have been caused by a cyclone, which stand above the jungle.

Geology.—The Moskos Group is mostly granitic, but many of the other islands are in the main sedimentary, being composed of considerably contorted beds of soft shales and sandstones, often showing signs of merging into quartzites.

Flora and fauna.—The forest, although not so lofty, partakes of the character of the typical rain forest, and is evergreen and rich in woody lianas and epiphytes; in the drier parts a species of casuarina is not uncommon. Pandanus is occasionally met with, and rubber (*ficus elastica*) is said to grow wild on some of the islands: a species of *Dipterocarpus* is in great demand for the resin which it yields. Plantains, coconut palms, and pineapples do not grow wild, but are found near the parts inhabited by fishermen.

The only really abundant mammals are monkeys, of which there are two species; a small chevrotain is found on some of the larger islands, and wild pigs appear to be fairly common.

Over 100 species of birds have been recorded, but many, being inhabitants of the jungle, are not usually seen; the most conspicuous bird is the hornbill, and herons are very common on the mud flats; pigeons, including the imperial pigeon, are found in the jungle, and the edible-nested swift breeds on certain of the islands.

Crocodiles are said to be very common in the muddy estuaries, and many species of water snakes have been recorded; lizards and geckos abound, and the large turtle is of commercial importance. Sharks are numerous, and the huge stingray is abundant.

Population.—The principal inhabitants are the Selungs, or sea gypsies, a nomadic, timid, and unobtrusive people, whose numbers it is difficult to estimate, as they cruise between the islands in their frail-looking canoes; they probably number over 800. There is a large influx of people to the archipelago between September and April, which is the pearling season.

Products.—The most important product is the shell of the mother-of-pearl oyster, for which divers go down to a depth of 28, and occasionally to 30, fathoms; the season is from September to May, and diving is only carried on at neap tides. Green snails and trocas shells are gathered for their mother-of-pearl shell, but, owing to the limited amount of coral bottom, the *bêche-de-mer* is not found in any great quantity; the edible birds' nests of the swift (*Collocalia unicorn*) and the eggs of the large turtle are collected.

The only two manufactures of the islands are torches and mats, the former made from the resinous tree, already mentioned, and the latter, simple and serviceable, woven from the strips of pandanus leaf.

Trade.—As much as 340 tons of pearl shell has been sent to Mergui in a season, which has realized £140 a ton, and 80 tons of green snails are often collected during the same period, selling at £45 a ton. The price of *bêche-de-mer* is £6 per ton, and only 5 to 20 tons will be obtained, but the birds' nests are sold at about double their weight in rupees, being about 10d. each, or some £5 per pound; turtles' eggs, from 200 to 300 in a nest, sell for about 3s. 6d. per hundred.

Nicobar Islands.—The Nicobar Islands, lying in the Bay of Bengal, between the 6th and 10 parallels north, and the meridians of 92° 40' and 94° east, occupy a space of 163 miles in a north-north-west and opposite direction, with an extreme width of 36 miles. The earliest mention of them is in the year 672, under the name of the Land of the Naked People, but, except in a few cases, the modern geographical names have not been traced to their sources.

They are a dependency of the Andaman Islands, consist of 12 inhabited and 7 uninhabited islands, and are generally hilly and undulating.

The chief summits are Mount Thullier (2,105 feet), on Great Nicobar; and Mount Deoban (1,428 feet), and Empress Peak (1,420 feet), on Little Nicobar.

Rivers.—The only island with rivers is Great Nicobar, on which are Galathea (Dak Kea); Alexandra (Dak Anaing); and Dagmar (Dak Tayal), considerable and beautiful streams.

Geology.—Little is known of the geology, but the southern islands are composed of sandstones and shales, and some of the northern of clay stones and conglomerates. Although forming part of a submarine chain known for its volcanic activity, there are no traces of true volcanic rocks.

Flora and fauna.—The timber trees are not so good as those of the Andamans, but coconuts, betel nuts, mellori, and thatching palms grow, and the palms are exceedingly graceful; large clumps of casuarina and great tree ferns are features of the landscape.

Of cultivated fruit are pumelos, lemons, limes, oranges, shaddocks, papayas, bael fruit, custard apples, bullocks' hearts, tamarinds, jacks, and plantains, besides sugar canes, yams, pineapples, and capsicums.

There are no indigenous wild animals, but some buffaloes and cattle left on Camorta have become wild. Monkeys are found on some islands, and crocodiles in the rivers, and of marine fauna are coral, bêche-de-mer, oysters, pearl oysters, turtle and tortoise shell, also edible birds' nests and an inferior quality of sponge.

Products.—Neither rice nor cereals are cultivated, but coconuts and tobacco are grown, and garden cultivation receives considerable attention. The inhabitants are good carpenters, and pottery for domestic use is manufactured.

Trade.—The export consists of whole coconuts and copra, edible birds' nests, split cane, betel nut bêche-de-mer, ambergris, and tortoise shell.

Ports.—There is a fine landlocked harbor, named Nancowry, between Camorta, Nancowry, and Trinkat Islands, and a small one between Pulo Milo and Little Nicobar, besides which there are a number of good anchorages.

Earthquakes.—The islands apparently lie in the local line of greatest fault, so that severe earthquakes may be expected, and ones of great violence are recorded in 1847, in 1881 (with a tidal wave), and milder shocks in 1899.

Climate.—The climate is very hot, except when raining, and unwholesome for Europeans, being in some places dangerously subject to malaria. The observations for temperature, etc., are very incomplete, but the highest temperature registered would appear to be

98.2°, and lowest 64° in the shade; the mean maximum at Nancowry Harbor is about 92°, and the mean minimum about 72°.

The rainfall varies considerably, as at Nancowry Harbor it was 93 inches in 1885 and 165 inches in 1887.

Andaman Islands, a group in the Bay of Bengal, which lies about 120 miles from Cape Negrais, in Burma, and about 340 miles from the north end of Sumatra, consists of 204 islands and rocks, and occupies a space of 219 miles in a north and south direction, with an extreme width of 32 miles. The Cocos and Preparis Islands are situated between them and Cape Negrais.

The principal islands consist of five, known as Great Andaman and named North, Middle, and South Andaman, Baratang, and Rutland Island, Little Andaman being 3 miles to the southward. The chief outlying islands are North Sentinel, Barren Island (800 feet), a volcano which has been quiescent for about a hundred years, and Narcondam (2,150 feet), also an extinct volcano, and which is 71 miles eastward of the group.

The name is supposed to be Malay, signifying "the abode of monkey people," and in a great Tanjore inscription of 1050 they are named Timatittivu, "Islands of impurity," and as the abode of cannibals; in Chinese history they were known as Rakshasas, or Ogres.

The islands, with the Nicobars, are administered by a chief commissioner, resident at Port Blair.

Physical features.—They consist of a mass of hills inclosing very narrow valleys, the whole covered by exceedingly dense tropical jungle. Especially on the east coast, the hills rise to a considerable elevation, the chief heights being Saddle Peak (2,402 feet), in North Andaman; Mount Diavolo (1,678 feet), in Middle Andaman; and Koib (1,505 feet), Mount Harriet (1,193 feet), and Cholunga Range (1,057 feet), in South Andaman; Fords' Peak rises to 1,422 feet on Rutland Island. Little Andaman Island, except in its north extreme, is practically flat. There are no rivers and few perennial streams in the group.

Geology.—Geologically the group forms a southward continuation of the Yoma Range, and consists of two sedimentary series, of which the first are non-calcareous gray sandstones and embedded shales, with occasional nests of poor coal, conglomerates, and pale-gray limestone. The other series consist of soft limestone formed of coal and shell sand, soft calcareous sandstones and white clays, with occasional conglomerates. Serpentine is found in the Cinque Islands and elsewhere, and chromite, asbestos, and valuable minerals may be expected.

Flora and fauna.—Pandanus and nipa palms grow near the sea, but coconuts and casuarina are not found. The forests are filled with evergreen trees, and the chief and most valuable timbers are padouk,

koko, chuglam, marblewood, and satinwood. There are bamboo groves and extensive mangrove swamps. Of introduced plants are tea, Liberian coffee, cocoa, ceara rubber, Manila hemp, teak, and a number of shade ornamental trees.

There are no dangerous mammals. The pig, wild cat, and iguana are hunted for food. The poisonous snakes include the cobra, the hamadryad, the blue karait, and two species of pig viper.

Population.—In 1911 the population of the Andaman and Nicobar Islands combined was 26,000.

Products.—The principal crops raised are rice, pulse, maize, sugar cane, and turmeric; tea, coffee, cocoa, rubber, and hemp are cultivated. Red clay for bricks, a reddish marble, red ochre, and mica, in workable quantities, are all found, and edible birds' nests, oysters, turtle, and tortoise-shell are obtained.

Trade.—Valuable woods are exported, as also tea, coffee, cocoa, rubber, edible birds' nests, turtle, and tortoise shell.

Ports.—The islands are deeply indented, forming a number of harbors, some very spacious; the principal are Temple Sound, Interview Passage, Port Anson, Port Campbell, Port Mouat, and Macpherson Strait, all on the west coast. On the east coasts are Port Cornwallis, Stewart Sound, Elphinston Harbor, Colebrooke Passage, Port Meadows, and Port Blair.

Climate.—Although tempered by sea breezes, the climate is always warm, and very hot when the sun is northing.

The rainfall is irregular, but it is usually dry during the northeast and very wet in the southwest monsoon. The average yearly fall is 116 inches, but there are fluctuations at the different stations, and it varies from 83 to 138 inches.

Earthquakes.—No violent earthquakes are reported, although the group lies in a line of fault; minor earthquakes occurred in 1868, 1880, 1881, 1882, 1883, 1886, 1894, and 1899.

Caution.—In the event of shipwreck, especially on or near Little Andaman Island, care should be exercised by the crew in dealing with the natives, who are greedy for loot, and might give considerable trouble on any attempt to prevent them from acquiring it.

They might be persuaded to convey a message to Port Blair, or to act as guides through the dense jungle to that port, but they are naturally timid, and if subjected to rough treatment, would probably desert the party.

Winds and weather—Monsoons.—The northeast and southwest monsoons blow over Ceylon and the Bay of Bengal, but their general direction and strength vary in different localities. The northeast and east winds of the former monsoon commence in the northern part of the bay in October, but the monsoon is not established until November, and at Ceylon not until the middle of that month.

At Ceylon the southwest monsoon commences about the middle of May, but occasionally it sets in before the end of April; in the Bay of Bengal it is not fully established till the latter half of June.

The southwest monsoon is stronger and more regular on the eastern than on the western coasts of Ceylon. From the middle of May to the middle of August the wind, commencing at about 8 a. m., by 10 a. m. has increased to a force of from 5 to 8, but it slackens about 4 p. m., and at sunset the force is from 2 to 3, gradually subsiding toward the morning.

Heavy seas and rain accompany the southwest monsoon, on the western side of Ceylon, but on the eastern side the latter is not experienced.

Bay of Bengal—Winds—January.—The northeast monsoon, blowing over the bay, extends as far south as the parallel of 4° south, the wind having a more northerly direction toward the head of the bay.

February.—The northeast monsoon prevails steadily over the bay, the winds varying from north-northwest to north-northeast at its head.

March.—The winds circulate anticyclonically, or in the same direction as the hands of a watch, being from southeast to southwest, in the west and northwest; northeast to east, in the south; and northwest to north over the northeast and east parts of the bay. Occasional squalls, which raise a high sea in the northwest angle of the bay, are experienced near the head, but they seldom last for more than three or four hours.

April.—The winds are variable and unsteady in the south, with southwest winds of increasing strength in the north, where strong winds from the northwest are not infrequent.

May.—The general direction is southwest, drawing somewhat to the southward off the Madras Coast and at the head; strong northwest winds come off the land occasionally at the head.

June.—The mean direction is southwest over the greater part of the bay, blowing between south-southwest and south-southeast at the head.

July.—The southwest monsoon holds steadily over the bay, its strength varying considerably, and periods of strong and lighter winds alternating; there is some decrease in its force from south to north.

August.—The wind conditions are practically the same as in July, but it draws slightly toward the south at the head, and toward the west in the eastern part. The mean force is between 4 and 5, but it varies considerably; squalls, sometimes preceding cyclones, attain forces of 8 and 9, and occasionally 10 and 11 at the head. The strength of the monsoon is considerably intensified in the center of the bay.

September.—The mean strength of the southwest wind is slightly less than in August, and is still lower over the Andaman Islands, but there is less variation, although strong winds still alternate with lighter ones; occasionally forces of 8 to 9 are experienced, but no cyclonic conditions, and squalls are frequent on the Arakan and Tenasserim coasts.

October.—The southwest or monsoon winds continue over the south and center of the bay, but north of the parallel of 16° north, northeast and east winds commence; the mean force of the monsoon wind is from 2.7 to 3.5, but it frequently increases to 5 and 7. This is the most variable and treacherous month of the year in the bay.

November.—The southwest monsoon winds have now entirely disappeared, and northeast winds, which in October were confined to the north, have extended to all parts of the bay. Between the parallels of 4° north and 4° south, and eastward of the meridian of 56° east, northwest winds, known as the "cross monsoon," prevail. High winds with forces of 9 to 10 may from time to time be experienced in all parts of the bay.

December.—The mean force of the northeast winds varies over the south part of the bay, from 3 to 4, but in the center sometimes attains the force of a gale.

The winds on the coasts, and in the center of the Bay of Bengal, taken from the Meteorological Atlas of the Indian Ocean, are given for each month of the year, and for easy reference, for those portions of the bay, for areas of 4° of latitude by 4° of longitude, as in that publication.

Latitude.	January.	February.	March.	April.	May.	June.
West coast:						
8°-12°.....	NE.....	NE.....	E. by N. .	SE.....	SW.....	SW.
12°-16°.....	ENE.....	E.....	SE.....	ESE.....	SSW.....	Do.
16°-20°.....	NE.....	SE.....	SW.....	SSW.....	SW.....	Do.
20°-24°.....	NNE.....	NNE.....	do.....	SW.....	do.....	Do.
Head of bay.....	do.....	NNW. to NNE.	W. by S.	do.....	do.....	SSW. to SSE.
East coast:						
20°-24°.....	NE.....	NE.....	NW.....	SSE.....	SSE.....	SSE.
16°-20°.....	NNE.....	N.....	NNW.....	WNW.....	SW.....	SSW.
12°-20°.....	do.....	NNE.....	NW.....	W.....	do.....	SW.
8°-12°.....	ENE.....	ENE.....	NE.....	E.....	do.....	WSW.
Center of bay.....	NE.....	NNE.....	NNE.....	W.....	do.....	SW.

Latitude.	July.	August.	September.	October.	November.	December.
West coast:						
8°-12°.....	WSW.....	SW.....	SW.....	W.....	NNE.....	NE.
12°-16°.....	do.....	WSW.....	do.....	E.....	NE.....	Do.
16°-20°.....	SW.....	SW.....	do.....	NNE.....	do.....	Do.
20°-24°.....	do.....	do.....	do.....	do.....	NNE.....	NNE.
Head of bay.....	SSW.....	do.....	do.....	do.....	do.....	Do.
East coast:						
20°-24°.....	S. by W.	S.....	SSE.....	E. by N.	ENE.....	NE.
16°-20°.....	SW.....	SW.....	SW.....	do.....	NE.....	Do.
12°-16°.....	do.....	WSW.....	do.....	SE.....	ENE.....	Do.
8°-12°.....	do.....	do.....	WSW.....	NW.....	do.....	ENE.
Center of bay.....	do.....	SW.....	SW.....	SSW.....	E.....	NE.

The following table shows the approximate direction of the wind at the Andaman and Nicobar Islands for each month of the year.

Place.	January.	February.	March.	April.	May.	June.
Andaman Islands.....	N.....	N.....	NW.....	WNW.....	SW.....	SW.....
Nicobar Islands.....	NE.....	ENE.....	NNE.....	W.....	do.....	Do.....

Place.	July.	August.	September.	October.	November.	December.
Andaman Islands.....	SW.....	SW.....	SW.....	SSW.....	NE.....	NE.....
Nicobar Islands.....	do.....	do.....	WSW.....	W.....	NW.....	Do.....

Weather—January.—The weather in this month is steadily fine.

February.—Fine over the whole of the Bay of Bengal, but occasional squalls near the east coast of Ceylon.

March.—Fine weather prevails as a rule over the bay, but occasional squalls, hail and thunder storms, come down from the hills on the Orissa and Bengal Coasts.

April.—Hot and sultry weather is experienced during the greater part of this month, with damp air, and the sky frequently clouded.

May.—The weather is frequently disturbed, and is changeable in the south, with intervals of fine weather alternating with cloudy and squally conditions, and heavy rain. Fairly fine weather and light winds usually prevail in the center, but it is hot and sultry; at the head it is fine. Squally, with thunder and lightning, near the Andaman Islands, increasing in violence and duration as the month advances.

June.—In the early part of the month the conditions are the same as in the latter part of May, with squally and showery weather in the south and southeast; hot and sultry weather in the center; and fine, with occasional thunder squalls, in the north. The moist, strong air current of the southwest Monsoon takes place about the middle of the month, with considerable irregular disturbance, severe squalls, and heavy rain, over the south part; the disturbed area advancing northward, and showers and rain squalls become frequent over all parts. These conditions prevail till the end of the month, when the monsoon is established.

July.—In the south and center of the bay the weather is generally fine, with strong winds, considerable cloud, and occasionally interrupted by rain squalls; but in the northern part it is more uncertain, varying between fine weather with lightly clouded skies, and stormy weather with severe westerly squalls, and hurricane winds near the centers, and southward, of the violent cyclonic storms of the month.

August.—This month is practically identical with July. The skies are more or less continuously clouded over all parts of the bay, with occasional rain squalls, particularly off the Coromandel and Burma Coasts.

September.—Generally similar to July and August; isolated squalls, of occasional occurrence all over the bay, are most frequent on the Arakan and Tenasserim Coasts.

October.—This month is very variable; the finest weather prevailing frequently for considerable periods in the center and north, while occasionally the largest and most severe cyclones of the year form, and blowing with hurricane force, cause a dangerous sea. Light airs and calms, with cloudy, showery weather, generally in the southern part, and prolonged intervals of fine clear weather, in the north and center of the bay.

November.—Generally fine throughout the greater part of the bay, except where disturbed by cyclonic conditions; showery and squally weather in the south.

December.—The month is fine as a rule over the center and northern parts of the bay, but is somewhat unsettled in the extreme south, where occasional heavy rains and cyclonic conditions are encountered.

Cyclones.—**Cyclonic storms**, an invariable characteristic of which is that in the northern hemisphere the wind blows round the area of lowest pressure in the opposite direction to the hands of a watch, and which ordinarily have in addition a progressive movement, are usually generated in the Bay of Bengal during the changes of the monsoons.

Occasionally, about May, cyclones of considerable intensity (or cyclonic storms) develop in the bay and move westward, usually northwestward; and about October, as the southwest monsoon gives way to the northeast monsoon, cyclones of very great intensity form in the bay, and are also propagated westward or northwestward. In both cases the areas exposed to their influence experience very bad weather, with rain and wind of hurricane force in the October cyclones.

Cyclonic storms of less force, but generally of greater area than those occurring at the changes of the monsoons, are most common during the southwest monsoon. These sometimes develop great force, but usually attain only the strength of a gale; they have no calm center, and are felt as partially revolving storms at the head of the bay, their influence further southward resulting in an increase in the force of the southwest monsoon. The main characteristics of these storms are comparatively small force of wind and torrential rain.

Cyclones of great violence are comparatively rare in the Bay of Bengal, an average of two occurring in each year; but there are sometimes four or five moderate cyclones in a month.

The area over which these storms extend varies from 20 miles to some hundreds of miles in diameter, the wind blowing with an ever-varying force, sometimes lulling into little more than a strong breeze, and as the center is approached often rising into a blast of irresistible

fury. One semicircle of the storm is known as the dangerous semicircle, because a vessel in it may possibly be driven across the path of the storm, and if running before the wind would certainly cross its path. The right hand is the dangerous semicircle in the northern hemisphere.

The following information, regarding cyclonic storms in the Bay of Bengal, is taken from the Meteorological Atlas of the Indian seas:

No storms of any consequence are recorded for the months of January, February, and March, and it would appear that in April they are of comparatively rare occurrence, but when experienced they have generally formed in the southern part of the bay, or near the Andaman Islands, and are more probable in the latter part of the month on the partial or irregular advance of the southwest monsoon.

Their general direction is to the northward, striking any part of the coast; one, recorded in 1895, originated in the southern part of the bay, and, taking a north and northeast course, passed over the Arakan Coast, near Akyab.

May.—Cyclonic storms are a characteristic feature of this month, those in the early part forming in the southern part of the bay, or near the Andaman Islands, while those later may originate in any part, but more often in the northern half. Their direction is anything between west and north-northeast.

June.—Nearly all storms develop near the head of the bay, northward of latitude 18° north, in this month, moving northwestward across the Orissa Coast of Bengal.

July.—During this month storms only occur in the northern part of the bay, forming generally northward of latitude 20° north, but they are of comparatively frequent occurrence, averaging two or three every year; their direction is in general more to the westward than in June.

August.—About the same average number of storms occur in this month as in July, and the locality of origin is also about the same.

September.—Storms form somewhat farther south in this month, generally northward of latitude 16° north, and their direction is more irregular than in either June, July, or August; they average about two every year.

October.—This is the most dangerous month in the bay, as storms may occur in any part, but usually originate near the center; their direction is varied, and they have a tendency to curve. As a general rule those forming west of longitude 90° east pursue a west-northwest, a northwest, or a northerly track, while those originating eastward of that meridian probably curve from northwest, by north, to northeast.

Two severe and very remarkable storms are recorded in the years 1901 and 1907. The first, known as the Port Blair Cyclone, which was northward of Borneo on October 22, passed close southward of Cambodia Point, across the Gulf of Siam and the Malay Peninsula, northward of Salang Island, from which its track was over Great Andaman Island and the Bay of Bengal until the meridian of 90° east, where, in about latitude 14° north, is commenced to curve to the northward, and, in about longitude 87° east, to the northeastward, up the northwest coast of the bay, arriving at its head on November 7.

The track of the storm of October 15 to 25, 1907, appears to be almost parallel throughout to the preceding, and from 250 to 300 miles farther to the southward.

November.—Cyclonic storms are sometimes nearly as frequent in this month as in October, and form in any part; those originating south of latitude 12° north have a westerly direction toward the Madras Coast.

December.—The occurrence of storms in this month is exceptional, but those that form do so in the extreme south, and have a northwest or north direction, curving to the northeastward; there is no record of them originating near the Andaman Islands in this month.

Barometer.—In the Bay of Bengal the movements of the barometer, indicating changes of weather, are comparatively small, a fall of three-tenths of an inch below the average for the place and time of the year occurring only before very disturbed weather, and this is not greatly exceeded, except in nearly the center of cyclonic storms.

Barometric pressure is highest across the Bay of Bengal in December and January, being about 30.05, but in February it begins to lessen, and is 29.85 in April and 29.60 in July; it commences to increase in August.

On account of the slight movement of the barometer preceding bad weather, it is necessary to allow for diurnal variations of pressure before attempting to predict changes; these variations, in the Bay of Bengal, are remarkably regular, and are somewhat larger in the northeast than in the southwest monsoon.

The highest points occur twice daily, viz, at about 9h. 30m. a. m. and 10h. 0m. p. m.; and the lowest at 4h. 30m. p. m. and 3h. 30m. a. m.

The average rise and fall during the northeast monsoon are:

Rise from a. m. lowest to a. m. highest, 0.08 inch.

Fall from a. m. highest to p. m. lowest, 0.09 inch.

Rise from p. m. lowest to p. m. highest, 0.07 inch.

Fall from p. m. highest to a. m. lowest, 0.06 inch.

During the southwest monsoon:

Rise from a. m. lowest to a. m. highest, 0.07 inch.

Fall from a. m. highest to p. m. lowest, 0.08 inch.

Rise from p. m. lowest to p. m. highest, 0.06 inch.

Fall from p. m. highest to a. m. lowest, 0.05 inch.

To reduce the barometric reading to temperature 32° F., the following are corrections for temperature of attached thermometer: Between 61 and 64° subtract 0.09 inch; between 65 and 68° subtract 0.10 inch; between 69 and 72° subtract 0.11 inch; between 73 and 76° subtract 0.12 inch; between 77 and 80° subtract 0.13 inch; between 81 and 84° subtract 0.14 inch; between 85 and 88° subtract 0.15 inch; between 89 and 92° subtract 0.16 inch; between 93 and 96° subtract 0.17 inch; between 97 and 100° subtract 0.18 inch.

Indications.—The indications of the approach of a cyclonic storm are an unsteady barometer, or even a cessation in its usual diurnal range; an ugly and threatening appearance of the weather, and the increasing number and severity of the gusts with the freshening of the wind; a long heavy swell or confused sea, which generally comes from the direction in which the storm is approaching.

The earliest indications of the approach of a cyclonic storm in the Bay of Bengal are not given by the barometer, unless in the area where the storm is in course of formation.

Before the False Point cyclonic storm of September 22, 1885, in which the barometer fell to the lowest point recorded in the Bay of Bengal, the barometer did not begin to fall sensibly until 10½ hours before the central calm passed over the signal station; but the weather assumed a threatening appearance 4 hours before the barometer began to fall, the wind being from northeast and blowing in fresh squalls, with an overcast sky, and heavy banks of clouds coming from the northeastward.

In front of the storm's path the first signs of its approach are a still, oppressive atmosphere, and, if it is traveling northwestward, which is a usual course, light variable winds from between north and east, a strong westerly current across the head of the bay, and a long southeasterly swell.

Light wisps of cirrus clouds move from the southwest, gradually thickening to a sheet of cirro-stratus, and the moon, when visible, is surrounded by a luminous halo. A ruddy glow is observed, especially at sunrise, and a low bank of clouds on the southeastern horizon is lighted at night by distant lightning. Waterspouts sometimes form in the still, vapor-charged atmosphere before it is stirred by an indraft toward the advancing vortex.

As a rule the barometer does not begin to fall steadily until the force of the wind is between 6 and 8, and the center of the storm is distant from 100 to 200 miles; the barometer then continues to fall

slowly until the center is from 50 to 20 miles off, and when the wind reaches force 12 the fall is very rapid until the center has passed.

No positive rule can be given as to the amount of depression to be expected, but at the centers of some storms the barometer stands fully 2 inches lower than outside the storm field.

The barometer rises in the rear of the storm similarly to the manner that it falls in front of it, rapidly near the center, and gradually beyond; sometimes the rise in the rear is slower than the fall in front. The weather in the front, however, is very different from that in the rear; in front, beyond about 200 miles from the center, the weather is fine, often calm and sultry, and no bad weather is experienced until the center of the cyclone is within 200 miles. In the rear the weather is squally and rainy for 400 to 500 miles from the center, southwesterly winds prevailing southward, and a southerly to southeasterly gale far eastward of the vortex.

It is difficult to estimate the distance of the center of the vortex from the vessel, partly from the uncertainty as to the relation between the bearing of the center and the direction of the wind, but principally from there being no means of knowing whether the storm is of large or small dimensions. If the barometer falls slowly, and the weather gets worse gradually, it is reasonable to suppose that the center is distant; and, conversely, with a rapidly falling barometer and bad weather increasing quickly, the center may be supposed to be dangerously near.

Bearing of center.—The wind in cyclonic storms blows in spirals toward the center of the storm.

Northward of latitude 15° north, in the Bay of Bengal, when within the influence of the storm, the bearing of its center is about 11 points to the right of the direction of the wind, and about 10 points when within 50 miles of the center.

Southward of latitude 15° north, the bearing of the center is about 11½ points, in the outer part of the storm, to 10 points near the center, to the right of the direction of the wind; and off the coast of Ceylon as much as 12 to 10 points, respectively. When on the outer edge of the storm, say 500 miles from the center, there may be an error of from one point to two points in the assumed direction of the center, obtained by applying the above rule; but as the wind increases in force the rule becomes more exact, although owing to local irregularities there may be an error of about a point in the assumed direction when within 50 miles of the center.

Rules for avoidance.—Constantly watch for the premonitory signs, and carefully observe and record the barometer.

When there is reason to believe that a cyclonic storm is approaching, the two points necessary for the seaman to know are the direction

in which the center of the storm is situated and in which semicircle the vessel is situated.

In order to ascertain these two points it is essential that the observer should be stationary; the first thing, therefore, to be done is to stop, keeping head to wind, or heave-to, and as it should be assumed that the vessel is in the dangerous semicircle, heave-to on the starboard tack. There should be no hesitation in stopping or heaving-to, as an early knowledge of the position of the ship in the storm is very desirable. When stopped or hove-to, face the wind and ascertain the bearing of the center as before directed.

Having ascertained the bearing of the center, the semicircle in which the vessel is situated is found by observing the direction in which the wind shifts. If it shifts to the right, the vessel is in the right-hand semicircle; if to the left, in the left-hand semicircle; and if the wind is steady in direction, but increasing in force, with a falling barometer, the vessel is in the direct path of the storm.

If an observer has reason to think that he is in the direct path of the storm, the best course is to run with the wind on the starboard quarter until the barometer has ceased to fall.

If the vessel is in the right-hand semicircle, remain hove-to on the starboard tack, as the wind will constantly draw aft until the barometer begins to rise.

If in the left-hand semicircle, run with the wind on the starboard quarter until the barometer begins to rise.

General remarks.—When running up the Bay of Bengal with a strong southwest wind, occasional squalls and rain, and a slowly-falling barometer, bad weather prevails somewhere to the northward.

Between the beginning of June and the middle of September the storm center is probably northward of latitude 16° north, and in July or August still further northward, and a sailing vessel should steer eastward and take advantage of the southerly and southeasterly winds on the eastern side of the storm as it moves northwestward. But should the weather get rapidly bad, and the barometer continue to fall, then heave-to, and determine the position with regard to the movement of the storm before proceeding.

In May, October, or November the storm travels in some direction from west, through north, to northeast; and its course should be definitely ascertained before any attempt is made to round its eastern side, as if it is moving northeastward such a proceeding would be attended with danger.

When leaving the Hugli from June to September notice of the approach of a cyclonic storm, or of the existence of a storm in the northern part of the bay, is given by easterly winds and a falling barometer, or by the storm signals at the telegraph stations. In July

or August the storm will probably be of moderate force, although not invariably so, but in June and September some most violent cyclones have visited the coasts of Bengal and Orissa. As a vessel standing southward would most likely run into the storm, the river should not be left until the weather has moderated.

In May, October, or November a squally easterly or northeasterly wind driving low, long-drawn masses of cloud before it, or a strong westerly current at the head of the Bay of Bengal, indicate that a cyclonic storm is in the northern part of the bay, and a vessel should not proceed southward until finer weather prevails.

But in these months a cyclonic storm may be far down the bay, and at the Hugli River, or other port at the head of the bay, there may be every appearance of fine weather. With these conditions, on the first indications of the coming storm, the changes of the wind and barometer should be carefully watched, and the course of the storm, if possible, be determined.

If in the right-hand semicircle the vessel should be hove-to on the starboard tack until the storm has passed, and if undoubtedly in the left-hand semicircle should heave-to on the port tack if the wind is eastward of north, or run southward, keeping the wind on the starboard quarter, when the wind is north or westward of north.

Vessels lying in the roadsteads of the Coromandel Coast on the approach of a cyclonic storm usually run southward round the southwestern quadrant, and this is probably the only course open to sailing vessels; but full-powered steamers leaving while the center is still more than 100 miles distant, and the wind between north and north-northwest, might, if necessary, proceed northeastward, if it has been ascertained that the storm is not moving northwestward or northward of that.

Vessels leaving Rangoon or Moulmein, and encountering strong northeasterly winds, with a falling barometer, denoting the existence of a cyclonic storm eastward of the Andaman Islands, should delay their departure until the storm has passed, which is indicated by a rising barometer, and the wind shifting to east or southward of east.

Storm signals.—The undermentioned storm signals, known as general, general with additional daily signals, and brief systems, and adopted at all the ports of British India, are shown at the following ports in the Bay of Bengal:

Ports under the general system.—Masulipatam, Vizagapatam, Kalingapatam, Gopalpur, Puri, Huki-tala, Diamond Harbor, Mud Point, Budge Budge, Calcutta, Cox's Bazar, Moulmein, Tavoy, Mergui, and Port Blair.

Ports under general system, with additional signals.—Negapatam, Porto Novo, Cuddalore, Madras, Cocanada, Sagar Island.

Sandheads, Chittagong, Akyab, Bassein, Diamond Island, Elephant Point, Rangoon, and Table Island.

Ports under brief system.—Chanbali and Balasore.

Special signals are used on the rivers of the Ganges Delta, and are shown at Morellganj, Barisal, Goalunda, Noakhali, and Naryanganj.

The meteorological department will keep port officers informed of the latest information with respect to all disturbances, and ships' officers should apply to them for information to supplement the storm signals.

General system—Distant signals:

No. I. CAUTIONARY SIGNAL.—By day: To indicate danger to ships after they have left the harbor, a black cylinder will be hoisted, placed horizontally, indicating that there is a region of squally weather in which a storm may be forming.

By night: Two white lights, hoisted vertically.

This signal will be hoisted at ports situated with reference to the disturbed weather such that a ship leaving the port might run into danger during its voyage.

No. II. WARNING SIGNALS.—By day: A black cylinder, hoisted vertically, indicates that a storm has formed.

By night: Two red lights, hoisted vertically.

This signal will be hoisted when there is no immediate danger of the port itself being affected, but ships leaving the port might run into the storm.

Local signals.—To indicate that the port and ships in it are threatened:

No. III. CAUTIONARY SIGNAL.—By day: A cone, apex downward, indicates that the port is threatened by squally weather.

By night: A white light placed vertically over a red light.

No. IV. WARNING SIGNAL.—By day: A cone, point upward, indicates that the port is threatened by a storm, but it does not appear that the danger is as yet sufficiently great to justify extreme measures of precaution:

By night: A red light placed vertically over a white light.

NOTE.—The existence of a storm can often be determined before its direction of motion can be fixed. In this case all those ports which the storm could possibly strike will be warned by this signal.

No. V. DANGER SIGNAL.—By day: A cone, point downward, hoisted vertically over a diamond shape, indicates that the port will experience severe weather from a storm of slight or moderate intensity that is expected to cross the coast to the south of the port (or to the east in the case of the Hugli Ports, Diamond Island, Bassein, Rangoon, and Andaman Islands).

By night: Two white lights hoisted vertically over a red light.

No. VI. DANGER SIGNAL.—By day: A cone, point upward, hoisted vertically over a diamond shape, indicates that the port will experience severe weather from a storm of slight or moderate intensity that is expected to cross the coast to the north of the port (or to the west in the case of the Hugli Ports, Chittagong, Rangoon, Muldmein, and Andaman Islands).

By night: A red light hoisted vertically over two white lights.

No. VII. DANGER SIGNAL.—By day: Two cones, points together, hoisted vertically over a diamond shape, indicates the port will experience severe weather from a storm of slight or moderate intensity that is expected to cross over or near to the port.

By night: A red light between two white lights hoisted vertically.

No. VIII. GREAT DANGER SIGNAL.—By day: A cone, point downward, hoisted vertically over a cylinder placed vertically, indicates that the port will experience severe weather from a storm of great intensity that is expected to cross the coast to the south of the port (or to the east in the case of the Hugli Ports, Diamond Island, Bassein, Rangoon, and Andaman Islands).

By night: A white light over two red lights hoisted vertically.

No. IX. GREAT DANGER.—By day: A cone, point upward, hoisted vertically over a cylinder placed vertically, indicates that the port will experience severe weather from a storm of great intensity that is expected to cross the coast to the north of the port (or to the west in the case of the Hugli Ports, Chittagong, Rangoon, Moulmein, and the Andaman Islands).

By night: Two red lights hoisted vertically over a white light.

No. X. GREAT DANGER.—By day: Two cones, points together, hoisted vertically over a cylinder placed vertically, indicate that the port will experience severe weather from a storm of great intensity that is expected to cross over or near the port.

By night: A white light between two red lights hoisted vertically.

No. XI. FAILURE OF COMMUNICATIONS.—By day: Two cones, points together, indicate that communication with the meteorological headquarters has broken down, and the local officer considers that there is danger of bad weather.

By night: A red light is hoisted.

Brief system.—For use at certain small ports.

In the brief system only the four following signals will be hoisted, but the port officers will be kept informed of the progress of bad weather for the general information of shipping.

Signal No. III, cautionary; signal No. IV, warning; signal No. VII, danger; signal No. X, great danger. Meaning of day and night signals is the same as in general system.

Weather signals—Additional daily signals for the Bay of Bengal.—In order to give daily information to a port regarding weather in the Bay of Bengal, the bay is divided into six sections, thus:

Section 1 contains the area north of latitude $18\frac{1}{2}^{\circ}$ north.

Section 2 lies south of 1; it is bounded on the south by latitude 13° north and to the east by longitude $88\frac{1}{2}^{\circ}$ east.

Section 3 lies south of 1 and east of 2; it is bounded on the south by latitude 13° north and to the east by a line from the position latitude 13° north, longitude 93° east to Diamond Island, together with the Arakan Coast, thence up to latitude $18\frac{1}{2}^{\circ}$ north.

Section 4 lies south of 2 and west of longitude 86° east.

Section 5 lies east of 4, south of 2 and 3, and west of longitude 93° east.

Section 6 lies east of 3 and 5, and represents the Andaman Sea.

If no disturbance exists in the Bay of Bengal the fact will be indicated by hoisting a ball.

If the port itself is threatened the appropriate local signal of the "general system" will be hoisted.

If there be an area of squally weather, or a storm that does not threaten the port, the "distant cautionary" or "distant warning" of the general system will be hoisted; and additional signs will be hoisted under these to indicate the position of the disturbance in the bay.

For this purpose the following shapes have been allotted to each of the sections:

Section 1, a cone, point downward.

Section 2, a cylinder, placed vertically.

Section 3, a diamond shape, formed by two cones, base to base.

Section 4, a cylinder placed horizontally.

Section 5, a cone, point upward.

Section 6, two cones, points close together.

Thus if there is squally weather in section 5 of the bay the signal hoisted would be a cylinder placed horizontally over a cone, point upward.

If a storm has formed in section 2 the signal, two cylinders placed vertically, one over the other, would be hoisted at all the ports which were not directly threatened. The ports threatened would hoist one or the other of the local signals.

If the center of the storm is near the boundary of a section two locality signals will be given, the first indicating the section in which the center is supposed to be, and the second the neighboring section near to which it is. In the event of a storm center being near to the angles where three sections meet three locality signals will be

hoisted. The first will give the section in which the storm is supposed to be, the second the nearest adjoining section, the third the remaining section.

These signals are also made on request at Sabang either by flags or radio telegraphy.

The call letters for the above, either by flags or radio telegraph, are Z K.

Weather information by radio for the use of ships.—The following arrangements for furnishing information regarding weather to ships at sea exist:

Information regarding weather will be distributed twice daily by radio from the existing coast radio stations as follows: ,

From Calcutta, at 13 hours and 1 hour Indian standard time; wave length 2,000 meters.

Rangoon, at 13 hours and 1 hour, Indian standard time; wave length 1,000 meters.

Madras, at 13 hours 10 minutes and 1 hour 10 minutes, Indian standard time; wave length 2,000 meters.

Port Blair, at 13 hours 10 minutes and 1 hour 10 minutes, Indian standard time; wave length 1,000 meters.

Indian standard time is $5\frac{1}{2}$ hours ahead of Greenwich mean time.

The sending station will signal the "all station" call five times before sending the message, in order to give ship stations an opportunity of obtaining the correct adjustment of their instruments.

The messages are distributed to ships free of charge.

Currents.—As knowledge of oceanic circulation increases it becomes more and more apparent that the currents are very variable both in rate and direction; and that even the most marked and permanent of them run in streaks which sway about in their course, producing great variations within a few miles, or at short intervals of time. The broad drift currents formed by the influence of the winds, which produce the more rapid and well-defined stream currents, naturally vary even more.

Ceylon.—The position of the island of Ceylon is a meeting or dividing point for the Oceanic current systems of the Indian Ocean, the Arabian Sea, and the Bay of Bengal; and this fact probably accounts for the very varying reports, given by vessels approaching the island from all positions, as to their direction and velocity.

When within from 12 to 15 miles of the coast, or within the 100-fathom contour line, the currents are very variable, and on the eastern and western sides of the island currents may be met with running parallel to the coast, but in diametrically opposite directions, at the same time and within a few miles of each other, but it would appear that the coast currents generally circulate around the island in the direction of the hands of a watch, during the northeast, and in

a contrary direction during the southwest monsoon, being variable at the changes.

Bay of Bengal—January.—Over the Bay of Bengal and the sea to the southward the general set is to the southwest and west, but along the Coromandel Coast, the set is to the southward, at rates of from 10 to 60 miles in 24 hours.

February.—In this month the currents show a complete circulation, the set being to the north and northeast, along the Madras and Orissa Coasts; to the east and southeast across the head of the bay; to the south and southwest on the east coast; and to the westward in the south and center. The velocity is greatest along the Madras Coast, where the northerly set is strong, the rates being from 10 to 60 miles in 24 hours.

March.—From Ceylon the current runs in a north and northeast direction up the Madras Coast so far as Gopalpur, and then turns to the eastward and sets across the north side of the bay, finally covering its east side as a southeast to southwest current. In the center of the bay, between the thirteenth and seventeenth parallels, the current is irregular.

April.—There is a fairly regular circulation in this month, as in March, the current running to the northward up the west side; to the eastward near the head, and down the east coast to the southward. Over the center of the bay the currents are irregular and weak.

May.—The currents are irregular, with very little movement near the Madras Coast, but farther out on the west side, and near the Andaman Islands, there is a fairly general and strong set to the northeast.

June.—The set is to the northeast and east over the west and north parts of the bay, but over the east and center the currents are complicated and weak in places.

July.—The currents are also unsteady and complicated in this month; the northerly set, up the Madras Coast, only extends so far as latitude 16° north, where it is met by a southeast current.

August.—The currents are again irregular, but generally the set is to the northeast; off the southern part of the Coromandel Coast the set is south, and off the Orissa Coast, southwest.

September.—An easterly set is general across the southern part of the bay, but in the bay itself the movement is irregular. A northerly current is found off the Madras Coast, a southwest set on the Orissa Coast; it is generally to the eastward in the center of the bay, but very complex about the Andaman Islands.

October.—The currents are confused, with no regular movement in the center of the bay, but in other parts there is a circular movement, which is in a contrary direction to that described for April;

the velocity is moderate to strong in the north and west, but generally weak elsewhere.

November.—There is more regularity in this month than in the preceding one, there being a general set to the east, southeast, and south over the surface of the bay, the most regular currents are those that set southwest and south off the Madras and Orissa Coasts.

December.—The currents are somewhat complicated over the Bay of Bengal during this month, although there is a general movement of the water to the west, southwest, and south; the strongest is that to the southward along the Madras Coast.

Tides.—The tidal wave appears to propagate itself in a northerly direction into the Bay of Bengal; then, expanding, it produces high water between 8h. 26m. and 9h. 45m. at full and change on the eastern coast of India, and generally between 10h. 0m. and 10h. 30m. at full and change on the eastern shore of the bay southward to Salang Island.

If the times of high water at different places on the shores of the bay be reduced to the standard time of Madras, it will be seen that high water occurs almost simultaneously at all the places situated near deep water, except on the east coast of Ceylon.

On the eastern coast of India the tidal rise at springs is, at Madras, $3\frac{1}{2}$ feet; at Cocanada, $5\frac{1}{2}$ feet; at False Point, 7 feet; at Eastern Channel Lightvessel, $10\frac{1}{2}$ feet; and at Sagar Island, at the mouth of the Hugli River, $15\frac{1}{2}$ feet.

At the mouth of Karnaphuli River, in the northeastern part of the Bay of Bengal, where the tidal wave is retarded owing to the shallow water in its vicinity, the rise is about 15 feet, and time of high water, full and change, is 0h. 30m.

On the eastern shore of the bay, southward to Bassein River, at positions not complicated by an extensive off-lying bank of soundings, the tidal rise at springs is $7\frac{1}{2}$ to 10 feet. In the Gulf of Martaban, where the water is shoal, the time of high water becomes later, it being high water, full and change, at China Bakir Lighthouse at 3h. 3m., and at Amherst at 2h. 21m.; and the tidal rise increases, it being 16 feet at China Bakir Lighthouse, and 20 feet at Amherst at springs.

Throughout the Nicobar and Andaman Islands the time of high water varies from 8h. 26m. to 10h. 24m., and the rise at springs between 5 and $9\frac{1}{2}$ feet.

Along the Tenasserim Coast, at the entrance of the Tavoy River, where comparatively shoal water extends some distance from the land, the spring rise is $15\frac{1}{2}$ feet; in Mergui Harbor, about 18 feet; and at Hastings Harbor, 14 feet; but at Salang Island, situated about 135 miles farther southward, where deep water is closer to the coast, the spring rise is 9 feet.

Between Malacca Strait and Nicobar Islands there are occasionally lines of heavy overfalls, which sometimes have the appearance of breakers.

Diurnal inequality.—The tides in the Bay of Bengal are largely affected by diurnal inequality, both of time and height.

The only general rule that can be given with regard to the principal inequalities of height is that the day tides are highest when the sun has north declination, and the night tides when the sun has south declination; this is more decidedly apparent at springs, but is not invariably the case at neap tides.

In the northern parts of the Bay of Bengal, as well as on the Martaban and Tenasserim Coasts, the diurnal inequality may either accelerate or retard the times of high and low water to the amount of nearly an hour, and increase or diminish the rise by upwards of 1 foot.

The bore.—No accurate observations have been made on the bores of the river mouths on the northern and eastern shores of the Bay of Bengal. These bores only occur at springs or other unusually high tides, and generally speaking the height of the wave in the navigable channels is not such as to affect a ship, though small craft keep out of its way or move off the shallows into the deeper water.

The best known of these bores are those of the Hugli and the Meghna, of Bengal; and the Pegu, and, especially, Sittang River, of Burma. They mainly occur during the southwest monsoon; but should the moon be in perigee at full or change, or other seasons, bores may then form.

Mud volcanoes.—A particular feature of the Arakan Coast is the number of mud volcanoes discharging marsh gas and sometimes flames, which occur not only on the mainland and the islands adjacent to it, but also in the sea in their vicinity, these latter constituting a serious danger to navigation, as they apparently happen in any part, although certain areas, probably governed by local lines of fault, seem to be more liable to them than others, and of these the neighborhood of The Terribles and Cheduba and Foul Islands may be mentioned.

On the last-named island an extensive eruption took place in February, 1908, which was described as a lurid flame rising to a height of about 500 feet, lasting for about a quarter of an hour, and followed by an explosive puff and a small flame which soon died out.

Mud volcanoes which occur in the sea frequently raise islets which may remain above water for some time or quickly sink, leaving dangerous shoals in their places, and a constant and careful lookout is necessary when navigating this coast.

An active mud volcano, with two summits, has appeared at a distance of about $8\frac{1}{2}$ miles southward of Baronga Point; this volcano,

on May 1, 1914, was about 30 feet in height and about 200 yards in extent.

The surface temperature of the sea in the Bay of Bengal is highest in May and lowest in February, the annual variation being about 3° in the southern part of the bay and 8° in the northern part.

In February the average temperature is 82° between Ceylon and the Nicobars, gradually decreasing toward the head of the bay to 77° . In the sea eastward of the Andamans the temperature in this month is 80° .

In May the average temperature of the surface water over the Bay of Bengal is 84° to 86° . A temperature of 87° is attained between Ceylon and the Nicobars; and 82° between the north end of Ceylon and Madras.

In August the average mean temperature of the surface water of the bay is 82° to 83° ; and it is the same in November.

Soundings.—On the south and east coasts of Ceylon the 100-fathom contour line is about 10 miles offshore, but deep, narrow guts approach the east coast in places, and throughout, where examined, the bank has a strongly marked and remarkably steep edge.

On the greater part of the coast of the Bay of Bengal the 100-fathom contour line is not defined, but from Madras northward as far as the mouth of the Penner River its distance from the coast is from 10 to 15 miles, increasing to 30 miles off Mutapoli Bank, and then resuming distances somewhat the same as the former as far as Cocanada.

Off the coast between Cocanada and the outlet of Chilka Lake its general distance from the shore is 25 miles, but across the head of the bay and as far south on the east coast as The Terribles it is not defined; from The Terribles to St. Johns Rocks it is from 30 to 35 miles offshore.

Deep soundings.—South of Ceylon and on a line across the mouth of the Bay of Bengal, until nearing the northwest end of Sumatra, the depths are over 2,000 fathoms.

Eastward of Calimere Point, and off the coast to the northward for a distance of about 200 miles, the depths are about 1,900 fathoms, from which they gradually decrease to the northward. The line of depth of 1,000 fathoms probably crosses the bay at about 150 miles from its head.

On the east coast of the bay the deep soundings are less than on the west, as soundings of 1,000 to 1,200 fathoms are met with at 100 to 150 miles offshore, shoaling again to the eastern side of the Andaman Islands. Between the Nicobar Islands and the coast are depths of from 1,400 to 1,600 fathoms, and in the center of the bay the general depths are from 1,700 to 1,800 fathoms.

Lights—Fishing vessels.—Fishing vessels and fishing boats, when under way and when not required by these regulations to carry or show the lights hereinafter specified, shall carry or show the lights prescribed for vessels of their tonnage under way.

(a) Open boats, by which it is to be understood boats not protected from the entrance of sea water by means of a continuous deck, when engaged in any fishing at night with outlying tackle extending not more than 150 feet horizontally from the boat into the seaway, shall carry one all-round white light.

Open boats, when fishing at night with outlying tackle extending more than 150 feet horizontally from the boat into the seaway, shall carry one all-round white light, and in addition, on approaching or being approached by other vessels, shall show a second white light at least 3 feet below the first light, and at a horizontal distance of at least 5 feet away from it in the direction in which the outlying tackle is attached.

(b) Vessels and boats, except open boats, as defined in subdivision (a), when fishing with drift nets shall, so long as the nets are wholly or partially in the water, carry two white lights where they can best be seen. Such lights shall be placed so that the vertical distance between them shall be not less than 6 feet and not more than 15 feet, and so that the horizontal distance between them, measured in a line with the keel, shall not be less than 5 feet and not more than 100 feet. The lower of these two lights shall be in the direction of the nets, and both of them shall be of such a character as to show all around the horizon, and to be visible from a distance of not less than 3 miles.

(c) Vessels and boats, except open boats, as defined in subdivision (a), when line fishing with their lines out and attached to or hauling their lines, and when not at anchor or stationary, shall carry the same lights as vessels fishing with drift nets. When shooting lines, or fishing with towing lines, they shall carry the lights prescribed for a steam or sailing vessel under way, respectively.

Fogsignal.—In fog, mist, falling snow, or heavy rainstorms drift-net vessels attached to their nets, and vessels when trawling, dredging, or fishing with any kind of drag net, and vessels fishing with their lines out, shall, if of 20 tons gross tonnage or upward, respectively, at intervals of not more than one minute make a blast; if steam vessels, with the whistle or siren, and if sailing vessels with the fog horn; each blast to be followed by ringing the bell.

Fishing vessels and boats of less than 20 tons gross tonnage shall not be obliged to give the above-mentioned signals, but if they do not they shall make some other efficient sound signal at intervals of not more than one minute.

Pilot vessels.—Pilot vessels, when engaged on their station on pilotage duty, shall not show the lights required for other vessels,

but shall carry a white light at the masthead, visible all around the horizon, and shall also exhibit a flare-up light or flare-up lights at short intervals, which shall never exceed 15 minutes.

On the near approach of, or to, other vessels they shall have their side lights lighted, ready for use, and shall flash or show them at short intervals to indicate the direction in which they are heading, but the green light shall not be shown on the port side, nor the red light on the starboard side.

A pilot vessel of such a class as to be obliged to go alongside a vessel to put a pilot on board may show the white light instead of carrying it at the masthead and may, instead of the colored lights above mentioned, have at hand ready for use a lantern with a green glass on the one side and a red glass on the other, to be used as prescribed above.

A steam pilot vessel, exclusively employed for the service of pilots licensed or certificated by any pilotage authority or the committee of any pilotage district, when engaged on her station on pilotage duty and not at anchor, shall, in addition to the lights required for all pilot boats, carry at a distance of 8 feet below her white masthead light a red light, visible all around the horizon, and of such a character as to be visible on a dark night, with a clear atmosphere, from a distance of at least 2 miles, and also the colored side lights required to be carried by vessels when under way.

When engaged on her station on pilotage duty, and at anchor, she shall carry, in addition to the lights required for all pilot boats, the red light above mentioned, but not the colored side lights.

Pilot vessels, when not engaged on their station on pilotage duty, shall carry lights similar to other vessels of their tonnage.

Searchlights.—Any vessel approaching a port in the British Empire or French colonies when searchlights are being worked, and finding that they interfere with her safe navigation, may make use of the following signals, either singly or combined:

(a) By flashing lamp, four short flashes followed by one long flash.

(b) By whistle, siren, or fog horn, four short blasts followed by one long blast.

Whenever possible, both flashing lamp signals and sound signals should be used.

On these signals being made, the searchlights will be worked, as far as circumstances will permit, so as to cause the least inconvenience, being either extinguished, raised, or their direction altered.

The signals should not be used without real necessity, as unless the vessel is actually in the rays of a searchlight it is impossible to know which searchlight is affected. The signals should be repeated until the inconvenience is removed.

These signals are designed to assist mariners, and do not render the Government liable in any way.

Naval dockyard.—The naval dockyard of the Royal Indian Marine is at Kidderpur, Calcutta.

Lightvessels—Riding lights.—The lightvessels in Indian waters exhibit the usual anchor white light on the forestay for the purpose of indicating the direction in which the vessel is riding.

Coal.—The following are coaling stations where more than 500 tons of coal are kept in stock: Colombo, Galle, Kankasanturai, Pondicherry, Madras, Calcutta, Chittagong, Akyab, and Rangoon. Less than 500 tons are kept at Cocanada, Moulmein, and Bassein; some coal is also kept at Negapatam, but its supply to vessels is uncertain.

Docks.—There are several docks at Calcutta; the dimensions and docking facilities are fully given in the appendix.

There are patent slips at Calcutta and Rangoon; their dimensions will also be found in the appendix.

Repairs.—Large repairs can be executed at Madras, Calcutta, Akyab, and Rangoon; and small repairs at Trincomali, Negapatam, Chittagong, Port Blair, and Moulmein.

Time signals.—Time signals are made at Madras, Calcutta, and Rangoon.

Radio stations.—There are radio stations at the pilot vessel at the Sandheads, Hugli River, at Diamond Island, Bassein River, Port Blair, Andaman Islands, Madras, Calcutta, Rangoon, Bassein Town, Table Island, and Point Victoria.

The stations at Bassein and Port Blair are only open to vessels in case of distress.

Uniform system of buoyage.—The following is the uniform system of buoyage adopted for Indian waters:

1. When approaching the coasts the position on the chart and the direction of the main stream of flood tide must be noted.

2. The term starboard hand denotes that side which would be on the starboard side of a vessel either going with the main stream of flood or entering a harbor, river, or estuary from seaward; the term port hand denotes the port side of a vessel under the same circumstances.

3. Buoys showing the pointed top of a cone above water are called conical, and are always starboard hand buoys, as above defined.

4. Buoys showing a flat top above water are called can, and are always port hand buoys, as above defined.

5. Buoys showing a domed top above water are called spherical, and mark the ends of Middle Grounds.

6. Buoys having a tall central structure on a broad base are called pillar buoys, and, like other special buoys, such as bell buoys, gas

buoys, automatic sounding buoys, etc., are placed to mark special positions either on the coast or in the approaches to harbors, etc.

7. Buoys showing only a mast above water are called spar buoys.

8. Starboard hand buoys are always painted a single red color.

9. Port hand buoys are painted of another characteristic color, either black or parti-color.

10. Spherical buoys at the ends of Middle Grounds are always distinguished by horizontal bands of white color.

11. Surmounting topmarks, such as staff and cone, etc., are always painted of one dark color.

12. Staff and cone are only used on starboard hand buoys; staff and cylinder on port hand; globes at the outer ends of Middle Grounds; and half globes, round part uppermost, at the inner ends.

13. Buoys on the same side of a channel, estuary, or tideway may be distinguished from each other by names or consecutive numbers or letters, commencing from seaward, and when necessary by a staff, surmounted by the appropriate topmark.

14. Fairway buoys are always painted in horizontal bands of white color, and are surmounted by a staff only.

15. Buoys intended for mooring, etc., may be of shape or color according to the discretion of the authority, within whose jurisdiction they are laid, but for marking submarine telegraph cables the color is green, with the word "Telegraph" painted thereon in white letters.

Buoys and marking of wrecks:

16. Wreck buoys in the open sea, or in the approaches to a harbor or estuary, are painted green, with the word "Wreck" painted in white letters on them.

17. When possible buoy shall be laid near to the side of the wreck next to mid-channel.

18. When a wreck-marking vessel is used she shall, if possible, have her top sides painted green, with the word "Wreck" in white letters thereon, and shall exhibit—

By day: Three balls on a yard 20 feet above the sea, two placed vertically at one end, and one at the other, the single ball being on the side nearest to the wreck.

By night: Three fixed white lights, similarly arranged, but not the ordinary riding light.

19. In narrow waters, or in rivers, harbors, etc., under the jurisdiction of local authorities, the same rules may be adopted, or, at discretion, varied as follows:

When a wreck-marking vessel is used, she shall carry a yard on a mast, with two balls by day, placed horizontally, not less than 6 nor more than 12 feet apart, and two lights by night, similarly placed.

When a barge or boat only is used, a flag or ball may be shown in the daytime.

The position in which the marking vessel is placed, with reference to the wreck, shall be at the discretion of the local authority having jurisdiction.

Magnetic variation.—The curve of no variation crosses the northern part of the Bay of Bengal from the coast about 80 miles southward of Cocanada in an east-northeast direction to Akyab, then turns southward and skirts the western shore of the Malay Peninsula; the curve of 1° west passes about 200 miles westward of the southern end of Sumatra and trends northward to the Nicobar Islands, passing about 100 miles westward of them; thence it trends to the northwestward and westward striking the coast of India in the vicinity of Pondicherri.

Passages—Full-powered steam vessels.—These passages are always as direct as circumstances permit.

Aden to Ceylon and Bay of Bengal.—Direct.

From April to October vessels should invariably pass to the northward of Sokotra, to avoid the heavy cross seas to the southward of it during the southwest monsoon, and at all seasons of the year it is advisable not to take the southern route if the Abd-al-Kuri is to be made at night, as the currents are often strong to the northward.

Bay of Bengal and Ceylon to Aden.—Direct, passing southward of Minikoi Island, and pass northward of Sokotra from April to October.

If following the direct route, vessels should steer so as to pass about 40 miles northward of Sokotra, giving the east end of that island a wide berth.

The usual practice in a steamer of moderate power during the southwest monsoon is, after passing Minikoi, to keep westward in the same latitude ($8^{\circ} 10'$ north) to longitude 60° east, and then to steer for the east end of Sokotra. By this track sail can be used from longitude 60° east to Sokotra, and the sea is not so directly ahead.

Certain officers in the mercantile marine, having great experience, strongly favor the route south of Sokotra and Abd-al-Kuri during the southwest monsoon, as the finer weather and smoother water experienced fully compensate for the additional 100 miles of this route over that to the northward.

From Colombo this alternative route is followed by steering so as to pass southward of Minikoi, in about latitude $7^{\circ} 30'$ north, crossing the meridian of 70° east in latitude $7^{\circ} 40'$ north, that of 50° east in latitude $8^{\circ} 0'$ north, and that of $53^{\circ} 15'$ east in latitude $10^{\circ} 0'$ north, afterwards edging away for Cape Guardafin, which must be approached with great caution.

Australia to Colombo and Calcutta.—From the southeast and south coasts: Direct around Cape Leeuwin.

From the north coast: As direct as possible, passing southward of Java.

Calcutta and Colombo to Australia.—The reverse of the preceding passage.

Cape of Good Hope to Bay of Bengal.—There are two routes. One through Mozambique Channel, calling at Seychelles Islands for coal, thence through One and a half degree Channel and around the southern side of Ceylon.

The other passes about 200 miles southward of Madagascar, calling at Mauritius for coal, and thence is direct around the southeastern side of Ceylon.

By the first route at all seasons the wind and sea are more favorable, and consequently there is less wear and tear.

Bay of Bengal to Cape of Good Hope.—Direct past southeastern side of Ceylon, eastward of the Chagos Group, calling at Mauritius for coal; make the African Coast in about 32° south, and keep in the strength of the Agulhas Current to abreast Mossel Bay, thence direct around Cape Agulhas.

From Rangoon, during the strength of the southwest monsoon, or in June, July, and August, pass eastward of the Andamans and Nicobars, thence direct to Mauritius.

Bombay to Bay of Bengal.—Direct around the south end of Ceylon. There is no channel between India and Ceylon except for small vessels of not more than 11½ feet draft through Pamban Pass.

Bay of Bengal to Bombay.—Direct around Ceylon.

Sailing vessels.—The routes followed by sailing vessels and those with low steam power in both monsoons are given in the tabulated forms following, observing that in all cases the set of the currents should be considered.

Sailing passage.	During southwest monsoon (April to September).	During northeast monsoon (October to March).
1. Cape of Good Hope to Bay of Bengal.	Round Cape of Good Hope, run down easting in 39° or 40° S. to 62° E., then steer northeastward to 28° S., 80° to 82° E., then northward in SE. trade; cross Equator in 82° E., thence direct to port. <i>See</i> Remarks following low-powered vessels as above.	Round Cape of Good Hope, run down easting in 39° or 40° S. (or farther south in January) to about 80° E., then steer northeastward to 28° S., 85° to 88° E., thence northward, cross Equator in 83° to 85° E., and pass 150 miles westward of northwestern end of Sumatra. Pass westward of Nicobar and Andaman Islands, whence the northern part of the Bay of Bengal is often made without tacking. In February or March keep well westward up the bay. If bound to Madras or east coast of Ceylon, shape direct course from position off Nicobar Islands.
2. Bay of Bengal to Cape of Good Hope.	From the Sandheads make for the Orissa Coast, sighting the land south of False Point, and working to the southwestward along the shore, make short tacks during the day and	Run down the bay, and cross Equator in 86° to 87° E., then steer to pass 300 miles southeastward of Rodriguez, and thence 90 miles southward of Madagascar. Make the African

Sailing passage.	During southwest monsoon (April to September).	During northeast monsoon (October to March).
2. Bay of Bengal to Cape of Good Hope (continued).	long boards off-shore during the night, bringing Kalingapatam aboard before leaving the coast and standing down the bay. A comparatively smooth sea and a favorable current will be found near the shore, and advantage may be taken of a veering wind in the squalls off the land. Cross the Equator in about 85° E., keeping on tack which makes most southing into southeast trade, when steer for Rodriguez; thence 90 miles southward of Madagascar, make the African Coast in about lat. 32° S., keep in the strength of the Agulhas current to abreast Mossel Bay, and then direct round Cape Agulhas. From Madras or Coromandel Coast stand at once across the Equator into southeast trade, then proceed as above.	Coast in about 32° S., and keep in the strength of the Agulhas current to abreast Mossel Bay, and then direct round Cape Agulhas.
3. Aden to Bay of Bengal.	Steer northward of Sokotra round Ceylon and direct to port. Low-powered vessels steam along the Arabian Coast to about long. 52° E., and then proceed to Ceylon or up the middle of the Bay of Bengal.	Along the south coast of Arabia to about 52° E., pass through the Eight or Nine Degrees Channel, then steer to round Ceylon, and having passed that island, make easting on parallel of 5° N. to about the middle of the bay, and then work northward. From 87° E. a vessel will probably fetch Madras. After mid-February round Ceylon at the distance of about 50 miles, and then proceed direct. This also applies to low-powered vessels.
4. Bay of Bengal to Aden.	Same as No. 2 into southeast trade. Then run westward, passing southward of the Chagos Group and northward of the Seychelles, cross the Equator in about 53° or 54° E., and make the African Coast at Ras Hafun. Great caution is necessary in making the land. Round Ras Asir and work along the African Coast as far as Burnt Island before standing across for Aden. Low-powered vessels.—If the southeast trade is near the Equator, as it may be from June to August, westing should be made in lat. 4° to 5° S. instead of to the southward of the Chagos Group.	Round Ceylon, through Nine Degree Channel, and northward of Sokotra. After mid-March pass southward of Sokotra. The above also applies to low-powered vessels.
5. Southeast Australia to Bay of Bengal.	By Inner or Outer Route to Torres Strait, then southward of Timor and Sandalwood Islands, keep in southeast trade till in about 85° E., then stand northwest, cross Equator in about 80° E., whence direct, allowing for strong easterly current. Low-powered vessels should always take the Inner Route to Torres Strait.	Through Bass Strait, direct for Cape Leeuwin not going southward of 10° S., then steer northwestward through the southeast trade so as to enter the northwest monsoon in 85° E.; then shape course toward Aceh Head, and proceed westward of Nicobar and Andaman Islands to destination. This track is usually taken from December to April.
6. Bay of Bengal to Southeast Australia.	As in No. 2 until in southeast trade, then keep on port tack, and when in the westerly winds proceed direct.	Run down the bay, cross Equator in 86° E., pass through northwest monsoon into southeast trade, stand across the southeast trade into the westerly winds, and then direct.
7. Malacca Strait to Calcutta.	Pass southward of the Nicobar Islands, thence direct for the Orissa Coast.	To mid-January pass eastward of the Andamans, after mid-January pass through Ten Degrees Channel, or Duncan Passage, and work northward in the middle of the bay.
8. Calcutta to Malacca Strait.	Direct through Preparis South Channel.	Through Preparis North or South Channel, and direct.
9. Rangoon or Moulmein to Calcutta.	Through Preparis North or South Channel, thence direct.	Round Alguada Reef, thence proceed northward about 30 miles off the coast of Burma before stretching across, but after January from Alguada Reef stand into middle of bay and work northward.
10. Calcutta to Rangoon or Moulmein.	Through Preparis South Channel, then steer to make China Bakir Lighthouse, if bound to Rangoon, but make Double Island if bound to Moulmein, allowing for tidal streams.	Round Alguada Reef and work eastward, keeping the lead going and allowing for tidal streams.

Sailing passage.	During southwest monsoon (April to September).	During northeast monsoon (October to March).
11. Bay of Bengal to Bombay.	As No. 2 into southeast trade, run westward between lat. 8° and 9° S., passing south of Chagos Islands. From 7½° E. steer to cross the equator in 62° or 63° E. and thence direct. Low-powered vessels follow the above route, but if the southeast trade is near the equator, make westing in lat. 4° to 5° S. instead of to the southward of the Chagos Archipelago.	Down the west side of the bay and at convenient distance from coast of Ceylon. After passing Cape Comorin keep in sight of the west coast of India, so as to profit by the sea breezes. Above also applies to low-powered vessels.
12. Bombay to Bay of Bengal.	From an offing in 15 to 20 fathoms water (or even 40 to 50 in first part of southwest monsoon, when the wind is well southward), stand down the coast of India, round the south end of Ceylon, and thence direct.	Direct round Ceylon. Thence make easting to middle of bay, and work northward. See No. 3.
13. Coromandel Coast to Rangoon or Moulemein.	Sight Landfall Island of Andaman Islands with southerly wind, or Great Coco Island with westerly wind. Pass through Coco Channel, thence eastward, sighting Narcondam Island, and then make China Bakir Lighthouse, if bound for Rangoon, or Double Island if for Moulemein.	Make northing in middle of bay, pass through Prepara's North or South Channel, then steer to make China Bakir Lighthouse, if for Rangoon, or Double Island if for Moulemein, keeping the lead going and allowing for tidal streams.
14. Rangoon or Moulemein to Coromandel coast.	Keep well out to sea if the wind becomes westerly, and endeavor to sight Narcondam Island. In working south, keep west of and a moderate distance from the Mergul Archipelago. Pass through Bengal Passage, thence work westward to destination.	Pass through Prepara's North Channel and thence direct, making the land to the southward after January.
15. Coromandel Coast or Ceylon to Malacca Strait.	Pass southward of Great Nicobar Island, guarding against southerly set, thence through Bengal Passage, sight Pulo Buton, and keep Malay side of strait.	If from Ceylon pass close southward of Great Nicobar Island, and endeavor to cross the Malay Coast. If from Madras pass through Sombbrero Channel of the Nicobar Islands.
16. Malacca Strait to Ceylon or to the Coromandel Coast.	Keep near north coast of Sumatra, then through Bengal Passage, and work across the bay in the height of the southwest monsoon, or in June, July, and August, and also when bound to Ceylon, from a good berth off Aceh Head cross the Equator into southeast trade, then a westerly course and recross the Equator in about 83° E. For Colombo recross the Equator in about 77° E.	To Ceylon pass on either side of Pulo Pera and between Pulo Rondo and Great Nicobar Island, thence direct, but if westerly winds are experienced near northern end of Sumatra, which is probable in October and November, keep northward. If to Coromandel Coast, keep on the Malay Coast until Salang or Junkseyon Island is reached, thence through either Ten Degrees or Sombbrero Channel (Nicobars). In December and January make the land northward of port on account of southerly set on Coromandel and Ceylon coasts.
17. Coromandel Coast or Ceylon to Calcutta.	Direct. Keep a moderate distance from the coast, make the land about Pundi (lat. 18° 40' N.), and use the lead. In September as in October.	Make easting across the bay, and northing on the east side or in the middle. In February and March, possibly steer direct, or stand to eastward. In October, stretch on or to North Andaman Island or Cape Negrais, when 100 miles westward of either, tack to northwest.
18. Calcutta to Coromandel Coast or Ceylon.	Makesouthing without closing the east side of the bay. Steer for port when 80 miles southward of it. If unable to work southward, passeastward of the Andamans and Nicobars and through Bengal Passage. Thence work across the bay, but in June, July, and August, stand across the equator into southeast trade, make westing, and recross the equator in about 83° E., then direct.	Steer direct. In September, with light south winds, work to southwest, keeping in soundings, or stand out to sea. Give the coast a berth in February and March, as the current then runs northward.
19. Malacca Strait to Rangoon or Moulemein.	Sight Narcondam Island, thence make China Bakir Lighthouse if for Rangoon, or Double Island if for Moulemein.	Sight West Torres Island, thence make China Bakir Lighthouse if for Rangoon, or Double Island if for Moulemein.
20. Rangoon or Moulemein to Malacca Strait.	As in No. 14, passing south point of Salang Island, and thence direct.	Keep outside Mergul archipelago, then sight the south point of Salang Island.
21. Rangoon or Moulemein to Aceh.	Endeavor to sight Narcondam Island and get westward toward Nicobar Islands, or make for the north coast of Sumatra, where the west current is favorable.	Steer direct.

Sailing passage.	During southwest monsoon (April to September).	During northeast monsoon (October to March).
22. Bay of Bengal to Mergui.	From the head of the bay pass on either side of the Coco Islands, but if from the Coromandel Coast, pass southward of Little Andaman Island, thence steer for Tenasserim Island.	From the head of the bay round Alguada Reef, or if from the Coromandel Coast, pass northward of the Andaman Islands. Thence work to the eastward and pass Tavoy Island on either side.
23. Mergui to Bay of Bengal.	For the head of the bay work to the westward and pass through Coco or Preparis Channels, but for the Coromandel Coast when clear of island work southward to the north end of Sumatra, passing through Bengal Passage, and so stand for the Coromandel Coast.	Through any channel north of the Andaman Islands and thence direct; but after January, if for the Coromandel Coast, pass southward of Little Andaman.

Aden to Bay of Bengal—Caution.—Several wrecks have taken place in recent years on Minikoi Island. Apparently these have occurred through steering to pass a few miles north of the light of the island (in some cases after having sighted the light from the eastward), instead of passing to the southward, where the light is a useful guide and protection.

In any case the practice of steering to pass a few miles north, especially by night, is a dangerous one, because the island is over 4 miles long in a north and south direction, and the current runs strongly at times to the southward.

General rules for sailing vessels navigating the Bay of Bengal:

Time of the year.	Bound northward.	Bound southward.
From January 15 to May 31.....	Take the western side.....	Take the eastern side.
In June, July, and August.....	Keep in the middle of the bay...	In the middle of the bay or take the eastern side, pass eastward of the Andaman Islands, and round Acheh Head.
In September, October, and November.	Take the eastern side.....	Take the western side.
In December and to January 15.....	Keep the middle of the bay and make short tacks.	Keep the middle of the bay.

Remarks.—The first outer passage from the Cape of Good Hope to the Bay of Bengal is taken if expecting to cross the Equator from May to September, with a certainty of gaining the port before the end of the southwest monsoon.

In proceeding northward gain easting to counteract the westerly current and to be prepared for the wind shifting northward, for in the southeast trade it often happens, particularly in April and May, that the wind is more from east and east-northeast than from southeast. The southeast trade at this season extends to the Equator, and from latitude 1° to 2° north the southwest monsoon, between May and September, is a fair wind to Calcutta or any part of the Bay of Bengal.

The Mozambique Channel, or Inner Route, is the most direct for vessels to any port of India during the southwest monsoon, but it

must not be taken unless there is a certainty of reaching the port before the close of the monsoon.

On leaving the cape, if with southeasterly winds, stand southward and run down the easting in latitude 39° to 40° south to about longitude 30° east; if with westerly winds, run along the coast, guarding against any indraft, keeping not northward of latitude 35° south until in longitude 37° east; then steer for Mozambique Channel, passing eastward of Europa Island and on either side of Juan da Nova, pass through the Comoro Islands, cross the Equator in about longitude 54° East, thence direct for the Eight Degrees Channel, and round the south end of Ceylon up the bay.

November to March.—The second outer passage is taken when it is likely that the Bay of Bengal will not be reached before the southwest monsoon is over, or when expecting to cross the Equator between October and April, and to arrive in the bay when the northeast monsoon has set in.

If the wind is westerly give the Nicobar and Andaman Islands a good berth, but if northeasterly steer up the bay close-hauled, passing westward of the islands unless bound to ports eastward of them. In about latitude 16° to 17° north the wind often shifts northward, when favorable tacks may be made to the eastward.

For the Hugli do not then approach either shore, but work to windward in the middle of the bay, where there is smooth water and moderate wind; from close westward of the Nicobar Islands the entrance of the Hugli has often been reached without tacking. If the Equator is crossed late in February or in March, keep well to the westward in standing up the bay.

If bound to Trincomali or Madras do not go eastward of longitude 90° east.

Bay of Bengal.—There is no difficulty in proceeding from southern to northern ports in the Bay of Bengal during the southwest monsoon, nor from northern to southern ports during the northeast monsoon. Vessels bound from a port on the eastern side to a port on the western easily make the passage during the northeast Monsoon. So also do vessels from a western to an eastern port during the southwest Monsoon.

When the monsoon is contrary, a sailing vessel must work up or down, as the case may be; or after standing some distance across the bay then shape course direct. At the change of the monsoon, voyages are usually tedious, for the light and variable winds then prevalent, being as often adverse as favorable, every slant should be taken advantage of and the northeastern part of the bay avoided, unless bound to, or from, one of the ports on that side of the bay.

In working down the Bay of Bengal in the southwest monsoon sailing vessels should keep well westward of the Andaman Islands,

that they may not be on a lee shore should a strong westerly gale set in; or, which is better, pass through Preparis North or South Channel, and then work southward in the comparatively smooth water eastward (or to leeward) of the Andaman and Nicobar Islands.

Fast sailing vessels from Calcutta, in the southwest monsoon, do beat down the Bay of Bengal, reaching about 100 miles westward of the Andaman Islands; but the wear and tear is great, and the saving in time slight.

Low-powered steam vessels take nearly the route of sailing vessels, except where given in the tabulated form. Such vessels at times take the route for full-powered steam vessels, but they must always be guided by their steaming capacity.

Money—British India.—The principal coin in use is the silver rupee, containing 180 grains of fine silver and 15 grains of alloy; for some years the rupee fell in value, but subsequently rose, and since 1898 it has been practically stable at 1s. 4d., and in 1899 an act made the value of the British sovereign 15 rupees. A lac, 100,000 rupees; a crore, 10,000,000 rupees. The subsidiary coins are: Silver, $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$ rupee; nickel, 1 anna (serrated), 1 penny; bronze, $\frac{1}{2}$ anna; 1 pice, $\frac{1}{4}$ anna; 1 pie, $\frac{1}{8}$ pice.

There is also a paper currency, 5, 10, and 50 rupee notes being legal tender everywhere in India proper, but other notes are only tender within the circles of their issue.

Siam.—Twenty-five santangs (1 salung), 4 $\frac{1}{2}$ d.; 4 salungs (1 tical or bat), 1s. 6 $\frac{1}{2}$ d. The coins are: Gold, 10 ticals; silver, tical, 2 salungs, 1 salung; nickel, 10 satang, 5 satang; bronze, 1 satang.

Weights and measures—British India.—The following are in general use:

Madras.—English measures and 1 kole or guz, 33 inches; 1 moolum, 19.5 inches; 1 puddee, 2.8852 pints; 1 mercal, 2.8852 gallons; 1 para, 14.4261 gallons; 1 tola, 180 grains troy; 1 cutcha ser, 4,320 grains troy; 1 viss, 3.0857 pounds avoirdupois; 1 maund, 24.6857 pounds avoirdupois; 1 candy, 493.7142 pounds avoirdupois.

Bengal.—One moot (4 ungulee), 3 inches; 1 háth, 18 inches; 1 guz, 1 yard; 1 coss, 2,000 yards; 1 jojun, 8,000 yards; 1 begah, 1,600 square yards; 1 ser, 1.76195 pints; 1 tola, 180 grains troy; 1 ser (16 chittaks), 2.059 pounds avoirdupois; 1 factory maund, 74.66 pounds avoirdupois; 1 bazár maund, 72.33 pounds avoirdupois; 1 imperial mound, 82.287 pounds avoirdupois; 1 masha (8 rutti), 15 grains troy; 1 ser (4 powá), 1.961 pints; 1 maund (40 ser), 9.8098 gallons.

Burma.—One pulgat, 1 inch; 1 taim or maik (8 thit), 5.5 inches; 1 toung or saading (4 taim), 22 inches; 1 lan (4 toung), 88 inches; 1 tha (7 toung), 154 inches; 1 okethapah, 85.56 yards; 1 tain, 1,069.44 yards; 1 dain (4 tain), 2,430 miles; 1 uzena, 15.555 square

miles; 1 lamyet, 1 gill; 1 salay, 1 pint; 1 sah, 1 gallon; 1 saik, 1 peck; 1 teng, 1 bushel; 1 coyan (100 teng), 12.5 quarters; 1 large ruay, 3.937 grains troy; 1 bai or anna, 15.75 grains troy; 1 moo, 31.5 grains troy; 1 mat, 63 grains troy; 1 tikal or kyat, 252 grains troy; 1 viss or piaktha, 3.6 pounds avoirdupois.

Siam.—One niu, 0.83 inch; 1 keup (12 niu), 10 inches; 1 sok (2 keup), 20 inches; 1 wah (4 sok), 80 inches; 1 sen (20 wah), 44.4 yards; 1 yot (400 sen), 9.875 miles; 1 thang, 3.75 gallons; 1 coyan, 375 gallons; 1 tical, 0.53 ounce; 1 tamlung (4 ticals), 2.1 ounces; 1 chang (20 tamlungs), 2 pounds 10.3 ounces; 1 hap (50 chang), 132½ pounds.

CAUTION TO BE OBSERVED WHEN APPROACHING BRITISH PORTS.

PART I.—CLOSING OF PORTS.

(1) As circumstances may arise in which it will be necessary, on account of periodical exercises, maneuvers, or otherwise, to forbid all entrance to certain ports of the British Empire, on approaching a port a sharp lookout should be kept for the signals described in the following paragraph and for the vessels mentioned in paragraph (5), Part II, of this notice, and the distinguishing and other signals made by them. In the event of such signals being displayed, the port or locality should be approached with great caution, as it may be apprehended that obstructions may exist.

(2) If entrance to a port is prohibited, three "red" vertical lights by night, or three "red" vertical balls by day, will be exhibited in some conspicuous position in or near to its approach, which signals will also be shown by the vessels indicated in paragraph (5), Part II, of this notice.

If these signals are displayed, vessels must either proceed to the position marked "Examination Anchorage" on the charts and anchor there or keep the sea.

(3) At all the ports or localities, at home or abroad, searchlights are occasionally exhibited for exercise.

Instructions have been given to avoid directing movable searchlights during practice onto vessels under way, but mariners are warned that great care should be taken to keep a sharp lookout for the signals indicated in paragraph (2) above when searchlights are observed to be working.

PART II.—EXAMINATION SERVICE.

(4) In certain circumstances it is also necessary to take special measures to examine vessels desiring to enter the ports or localities, at home or abroad.

(5) In such case vessels carrying the distinguishing flags or lights mentioned in paragraph (7) will be charged with the duty of examining vessels which desire to enter the ports and of allotting positions in which they shall anchor. If Government vessels, or vessels belonging to the local port authority, are found patrolling in the offing, merchant vessels are advised to communicate with such vessels with a view of obtaining information as to the course on which they should approach the Examination Anchorage. Such communication will not be necessary in cases where the pilot on board has already received this information from the local authorities.

(6) As the institution of the examination service at any port will never be publicly advertised, especial care should be taken in approaching the ports, by day or night, to keep a sharp lookout for any vessel carrying the flags or lights mentioned in paragraph (7), and to be ready to "bring to" at once when hailed by her or warned by the firing of a gun or sound rocket.

In entering by night, serious delay and risk will be avoided if four efficient all round lamps, two "red" and two "white," are kept available for use.

(7) By day the distinguishing flags of the examination steamer will be a special flag (white and red horizontal surrounded by a blue border) and a blue ensign; also three red vertical balls if the port is closed.

By night the steamer will carry "three red" vertical lights if the port is closed and "three white" vertical lights if the port is open.

The above lights will be carried in addition to the ordinary navigational lights and will show an unbroken light around the horizon.

(8) Masters are warned that when approaching a British port where the examination service is in force they must have the distinguishing signal of their vessel ready to hoist immediately the examination steamer makes the signal.

(9) Masters are warned that before attempting to enter any of these ports when the examination service is in force they must, in their own interests, strictly obey all instructions given to them by the examination steamer. In the absence of any instructions from the examination steamer they must proceed to the position marked "Examination Anchorage" on the charts and anchor there or keep the sea.

While at anchor in the examination anchorage masters are warned that they must not lower any boats (except to avoid accident),

communicate with the shore, work cables, move the vessel, or allow anyone to leave the vessel without permission from the examination steamer.

(10) In case of fog, masters of vessels are enjoined to use the utmost care, and the Examination Anchorage itself should be approached with caution.

(11) Merchant vessels when approaching ports are specially cautioned against making use of private signals of any description, either by day or night. The use of them will render a vessel liable to be fired on.

(12) The pilots attached to the ports will be acquainted with the regulations to be followed.

CHAPTER II.

CALIMERE POINT TO COCANADA.

Calimere Point is the northwestern entrance point to Palk Strait and Bay, and the southern point of the Coromandel Coast. About 3 miles westward of the point are the Kodigeri Bungalows, formerly a hot-weather resort, and 5 miles northward of the point, and a mile inshore, are two dark-looking pagodas, shaped like oblong haystacks, which are in line bearing 270°.

Light.—On Calimere Point is a cement tower, 52 feet in height, from which is exhibited, at an elevation of 42 feet above high water, a flashing white light, visible 12 miles. (For details see Light List.)

A sand bank, dry at low water, inside which trading boats find shelter in bad weather, extends about $1\frac{1}{2}$ miles northeastward of Calimere Point.

Depths offshore.—The 5-fathom contour line is about 7 miles and that of 3 fathoms about $1\frac{1}{2}$ miles southeastward of Calimere Point.

Forest reserve.—In the vicinity of Calimere Point is a government forest reserve, where antelopes, spotted deer, and wild pigs are strictly preserved. Landing or shooting in the neighborhood is prohibited.

Middle Banks consist of six detached shoal patches, with depths of from $1\frac{1}{4}$ to 3 fathoms over, and deeper water between them, which extend over a space of 8 miles in a north and south direction, with a greatest width of 3 miles.

The northwest patch, on which there is a depth of $2\frac{1}{4}$ fathoms, is situated about 4 miles south-southeast of Calimere Point Lighthouse, and the channel between it and the 3-fathoms contour line, southward of Calimere Point, is about $1\frac{1}{2}$ miles in width, but a depth of more than $3\frac{1}{2}$ fathoms can not be relied on.

Directions.—In rounding Calimere Point by the channel between the shoal water off the point and Middle Banks, the position may be obtained by cross bearings of the Kodigeri Bungalows, the lighthouse, and the two pagodas northward of the point. The lead must be carefully used, and between Point Pedro and Calimere Point vessels standing westward or toward Middle Banks should not shoal to less than 8 fathoms.

Coromandel Coast.—The name Coromandel (of doubtful origin, but generally supposed to be a corruption of Chola-mandalam) is generally applied to the coast of the peninsula of India, between Calimere Point on the south and Kistna River mouth on the north, a distance of about 365 miles. It is divided into the districts of Tanjore, South Arcot, Chengalpat, and Nellore, which are described in Chapter I.

All this coast is low and sandy, and exposed to a very heavy surf, the artificial harbor of Madras alone affording shelter for European shipping. Northward of Sadras (about 40 miles southward of Madras) the sea appears to have encroached upon the land to a considerable extent.

Coast.—From Calimere Point the coast, trending in a northerly direction for about 28 miles to Negapatam, is low, fringed with groups of palmyra and casuarina trees, and should not be approached nearer than depths of from 7 to 8 fathoms, which are found from about 5 to 10 miles offshore, the water being deeper nearer the shore as Negapatam is approached, but in the vicinity of Negapatam Shoal a vessel should not go inside the 10-fathom contour line.

The two dark-colored pagodas 5 miles northward of Calimere Point, already alluded to, are the only distinguishable marks between that point and Negapatam.

Currents.—Vessels making the east coast of India should bear in mind that it is not at all unusual to experience currents setting from 2 to 3 knots in the offing. From February to July a strong current to the northward, and from October to December to the southward, may be expected but is not always experienced. During the progress of the survey in 1901 currents of from 1 knot to 2 knots were experienced outside the 20-fathom contour line, decreasing between the 20 and 10 fathom lines, with little or none inside the latter, while close in to the coast the current was occasionally reversed.

A set was usually found out of Palk Strait when the current was running to the northward in the offing, and it is presumed that the reverse takes place when the current runs to the southward. Close inshore tidal streams are felt, and they vary the strength of the current in the neighborhood of Middle Bank.

Negapatam Shoal, composed of hard sand and stones, is about 6 miles in length in a north and south direction, $\frac{1}{2}$ mile in breadth, and has general depths over it of from 4 to 5 fathoms, with several heads of $3\frac{1}{2}$ to $3\frac{3}{4}$ fathoms. The least water found on the shoal in 1901 was $3\frac{1}{2}$ fathoms, but a depth of less than 3 fathoms was reported in 1860. The northern end of the shoal, $7\frac{1}{2}$ miles 142° from Negapatam Light, is steep-to, with depths of 7 fathoms outside and 6 fathoms inside it; the southern end is ill-defined.

Negapatam, the principal seaport of Tanjore District, is situated at the mouth of the small Kaduveiyaru River. Salt is stored in large quantities at Negapatam. The limits of the port are defined by boundary pillars.

Landmarks.—The lighthouse, the tall spire of the church, about 1,000 feet northwestward of it, and the minaret, 148 feet high, at Nagar, besides four similar but smaller towers and two chimneys of the South Indian Railway workshops, are conspicuous marks for fixing a vessel's position. There are also two large Hindu temples, one in the center and the other in the southwestern part of the town.

Light.—From a white masonry column 83 feet in height, situated about 200 yards westward of Kaduveiyaru Entrance, a group occulting white light is exhibited at an elevation of 80 feet above high water. It should be visible seaward for a distance of 14 miles. (For details see Light List.)

Storm and weather signals are shown from the lighthouse.

Shoals.—Three small sandy shoals lie in the space of 1 mile in a north and south direction outside the 5-fathom contour line, the southern, with a depth of $4\frac{1}{2}$ fathoms, being 2.6 miles east-northeastward of the lighthouse.

Anchorage.—The anchorage off Negapatam is open to all but westerly winds, but the holding ground, of mud, is good, and the water shoals gradually; in heavy weather a short broken sea sets up. Vessels anchor according to their draft of water and the state of the weather; in fine weather a good position is in depths of from $3\frac{1}{2}$ to 6 fathoms with the lighthouse bearing from 225° to 280° ; during the northeast monsoon it is unadvisable to anchor in less than 5 fathoms.

Directions.—Vessels bound to Negapatam around the north end of Ceylon should keep outside the 10-fathom contour line when near Point Pedro Shoal, and not go under 8 fathoms off the Middle Banks; between Calimere Point and Negapatam they should also be outside the 10-fathom contour until the conspicuous church spire bears westward of 310° , which leads 1 mile northward of Negapatam Shoal.

In the northeast monsoon sailing vessels should make the land northward of the port, as the current then runs strongly southward and into Palk Bay, and leaving the port during that monsoon the southerly current must be considered and sailing vessels require a press of sail in order to clear the northeastern coast of Ceylon.

River and bar.—The filling of Kaduveiyaru River in July annually by freshets causes an opening off the end of the jetty which gradually works southward as the river begins to fall. About December a sand spit forms, which gradually increases until early in July, when it nearly blocks the river's mouth. In very fine weather

ships' boats can cross the bar without danger, although with the risk of a wetting; a steering oar is indispensable.

Tides.—It is high water, full and change, at Negapatam at 9h. 0m.; springs rise $2\frac{1}{2}$ feet and neaps $1\frac{1}{2}$ feet.

Town.—Negapatam was one of the earliest settlements of the Portuguese on the east coast and ranks as the ninth largest town in the presidency; it has several temples, only one being ancient, and is an important center of emigration to the Straits Settlements and Natal. In 1911 the population was 60,168.

Communication.—Steamers of the British India Steam Navigation Co. between Madras, Rangoon, Penang, and Singapore call weekly, and those between Bombay and Calcutta fortnightly; there is a regular service by the Asiatic coasting steamers. There is communication by rail with the Indian railway system, and telegraphic communication with all parts.

Coal and supplies.—In case of necessity coal in small quantity might be obtained from the South Indian Railway Co., but they do not undertake to supply it under any other circumstances; it is brought off in boats holding about 5 tons.

A limited supply of fresh meat may be procured, but 24 hours' notice is necessary. Vegetables and bread can be obtained from Madras: water is good, and sent off in tanks holding 400 gallons.

Repairs.—Small repairs to machinery might be effected at Negapatam, but none can be executed in the foundries of the South Indian Railway Co. Boats drawing 4 feet unload at high water at a wharf on the bank of the river, 200 yards southward of the lighthouse. On the wharf is a crane capable of lifting 10 tons.

Trade.—The principal exports are rice, cotton piece goods, ground nuts, live stock, tobacco, cigars, turmeric, and skins; and imports, areca nuts, gunny bags, camphor, cotton piece goods, and apparel.

Quarantine.—A vessel with cholera or smallpox on board should hoist the International Code flag R at the foremast. The regulations under the Venice sanitary commission on account of plague are in force.

Hospital.—Seamen are taken as inpatients at the civil dispensary.

Current.—The current off Negapatam generally sets with the wind, and appears to depend upon its direction and force.

Nagar (Nagore), $3\frac{1}{4}$ miles northward of Negapatam, on the right bank of Vettar River, is remarkable for its mosque and minaret; the main tower of the minaret, 148 feet in height, is visible from seaward before the coast.

Town.—Nagar town has chiefly a Mohammedan population, and there is a considerable trade carried on by native vessels with Burma and the Straits Settlements; an annual feast held here is largely at-

tended by pilgrims. For municipal purposes it is united with Negapatam.

Vettar River at Nagar is about 200 yards in width, but blocked by islets and shoals, and obstructed by a shifting bar, having about 4 feet over it, similar to that at Negapatam.

Anchorage.—There is open anchorage eastward of Nagar in $3\frac{1}{2}$ to $4\frac{1}{2}$ fathoms from $\frac{1}{2}$ to $\frac{3}{4}$ mile offshore, and in deeper water farther seaward; the holding ground is good. The left bank of Vettar River defines the northern limit of the port of Nagar; southward the port joins that of Negapatam.

Communication.—A branch railway connects Nagar with Negapatam.

Coast.—From Negapatam to Cauverypatam, about 23 miles northward, the coast continues very low and flat.

Karikal, nearly 6 miles northward of Nagar, on the left bank of Arasalar River, is situated more than 1 mile inland; the coast in this vicinity is very low, with a few fishing villages. Koluncherri and Tirumali Rivers, both like the Arasalar, barred streams, flow into the sea between Karikal and Nagar. These rivers can only be navigated after heavy rains have sufficiently swollen their streams, when cargo may be landed in flat-bottomed boats.

Landmarks.—The first objects seen on approaching Karikal are, from southward, the high minaret of Nagar, and from northward, the dome of Karikal Church, which stands rather more than 1 mile from the beach, and the light tower.

Light.—From a stone tower, 56 feet in height, painted white, and about 200 yards from Arasalar River mouth, is exhibited, at an elevation of 59 feet above high water, a fixed white light, visible 10 miles.

Signal station.—The flagstaff generally flies the French flag, and communication can be made with it by the International Code.

Anchorage, said to be the best on this coast, may be obtained in from 5 to 6 fathoms water, over mud and sandy bottom, with Karikal Light Tower bearing 265° .

Bar signal.—A blue flag hoisted at the beacon tower indicates that the bar is heavy and communication is prohibited.

Arasalar River.—The lading and unlading of cargo is carried on with little difficulty in Arasalar River, but the bar, which is marked by rollers, is very dangerous in October, November, and December; the depth of the mouth of the river is 8 feet at high-water springs.

Tides.—It is high water, full and change, at Karikal, at 9h. 0m.; springs rise $4\frac{1}{2}$ feet, neaps rise 2 feet.

Town.—Karikal is a French possession; the population of the whole settlement in 1913 was 60,154.

Trade.—In 1913 the chief exports consisted of rice, bricks, and pottery; the principal articles of imports were wines, spirits, and petroleum. The Standard Oil Co., of New York, stores large quantities of the latter, both in cases and in bulk, Karikal being a depot and distributing center for the surrounding districts.

Communication.—Steamers of the British India Steam Navigation and Asiatic Cos. call regularly at Karikal. A branch line of the South Indian Railway runs from Karikal to Peralam, but it requires to be extended from the town to the beach.

Coal and supplies.—Coal can be obtained by giving notice to the contractors, but only 1,500 tons are imported annually; there are 30 lighters of 40 tons, and 400 tons of coal could be put on board in 24 hours, but northeast winds impede coaling.

Supplies of fresh meat, bread, and vegetables may be procured and drinking water in barrels.

Landing should not be attempted with ships' boats; there is a well-organized native boat service under the harbor-master; the only boats used are the surf boats, here called chelingues.

Current.—The current is generally inappreciable close inshore, but sets strongly in the offing, to the northward from February to July and to the southward from October to December.

Winds.—The northeast monsoon begins in October and ends in March; the southwest monsoon begins in March and ends in October. The changes of the monsoons are usually accompanied by bad weather. Cyclonic storms are rare, but they usually occur near the middle of November, or beginning of April. The rainy season commences toward the end of June and ends at the latter part of November.

Tranquebar is situated about $6\frac{1}{2}$ miles northward of Karikal, on the left bank of a river, which is navigable only by native boats. The old fort of Dansborg, some large white houses, and lookout tower indicate its position from the offing. A small grove of casuarina trees flanks the south side of the town. The sea has encroached considerably abreast the fort, and protective stone groynes, which should not be approached too closely in boats, extend about 200 yards seaward.

Anchorage may be obtained in depths of from $5\frac{1}{2}$ to 6 fathoms about $\frac{3}{4}$ mile offshore, with the fort bearing about 280° .

Town.—The town is one of the healthiest places in the district; the European bungalows are mostly situated within Dansborg Fort, but the majority of the natives reside in Poraujar about 1 mile inland; in 1901 the population was 13,142.

Communication.—Steamers of the British India Steam Navigation Co. call occasionally, and it is proposed to connect the town with the South Indian Railway system by a branch line.

Supplies.—Fresh meat, vegetables, bread, and poultry are procurable only in small quantities. Fresh water for shipping is obtainable from the river during the freshes, from July to December.

Landing.—Cargo is landed on, and shipped from, the beach abreast the customhouse in masula boats, each carrying about 4 tons. During the northeast monsoon there is a depth of about 6 feet at high water on the river bar, when native craft of about 150 tons enter for repairs.

Trade.—The principal articles of export are twist, piece goods, coir, and spices, but there is now very little trade.

Cauverypatam, with two pagodas, is situated about 7 miles northward of Tranquebar. The land northward of Cauverypatam begins to rise slightly, after being low and flat from Calimere Point.

Tirmelwassel, in Tanjore District, about 6 miles northward of Cauverypatam, is a small town with a pagoda, situated near the mouth of the river, one of the many branches of the Cauvery.

Flagstaff.—A flagstaff for signaling purposes, 75 feet in height, stands just northward of the customhouse, which is a low, tiled building on the left bank of the river, at Tirmelwassel. The flagstaff, which is the only landmark on this part of the coast, can be seen over the tops of the trees when approaching from the southward.

Anchorage.—Two boundary pillars on the coast mark the northern and southern port limits, and anchorage may be obtained in 5 to 6 fathoms water, with the flagstaff bearing from 247° to 270°.

The anchorage should be approached with caution, as the soundings shoal rapidly inside the 5-fathom contour line.

South Arcot District, of which Coleroon River is the southern boundary, has a coast line of about 50 miles; its ports being Porto Novo and Cuddalore. See Chapter I.

Coleroon River is 94 miles in length, drains an area of 1,404 square miles, and flows into the sea by two mouths, one 10 miles and the other 13½ miles northward of Tirmelwassel. The southern mouth has a shoal extending 1,200 yards off it and on which the sea breaks heavily during the strength of the northeast monsoon.

The waters of Coleroon River are controlled by three dams, and are largely used for irrigation purposes; it is crossed about 10 miles above its mouth, by the South Indian Railway, over a girder bridge. The river is navigable, by small craft, for a few miles from its mouth, and rice is exported from it. The four Chillumbrum pagodas, situated about 7 miles westward of Coleroon River mouth, are remarkable, and can be distinctly seen over the trees abreast of Coleroon River.

Coleroon Point is formed by a long sandy spit, just above high water, extending 3½ miles to the northward of the southern entrance to Coleroon River; the point, having no vegetation on it, is difficult

to distinguish from seaward. Between Coleroon Point and the mainland, a distance of $1\frac{1}{2}$ miles in a westerly direction, are numerous sand banks covered and uncovered.

Porto Novo is situated on the left bank of Vellar River, 3 miles northwestward of Coleroon Point.

Vellar River.—The Vellar River, which for some distance forms the boundary between Trichinopoli and South Arcot, has a total length of 135 miles and has several dams across it for irrigation purposes. The depth on Vellar Bar is 3 feet at low water to $4\frac{1}{2}$ feet at high water, spring tides; the river is broad and shallow.

It is tidal for 7 or 8 miles from its mouth and for part of that distance is navigable by small craft at all seasons of the year; about 2 miles southward of its mouth it is supposed to meet the waters of the Coleroon, and every year, in the Tamil month Masi (February-March) a procession, with an idol, congregate on the shore abreast this spot, and the people bathe. Native craft enter the river for repairs, and cargo is landed at a jetty opposite the customhouse.

Anchorage.—From about the middle of October to nearly the end of December, vessels should anchor from 2 to 3 miles offshore in depths of from 6 to 9 fathoms, with the flagstaff bearing about 260° , but after the month of January, during the southwest monsoon, and in fine weather, anchorage may be taken up closer in, according to draft.

Directions.—The 10-fathom contour line passes only about 1 mile outside the shoal water of the southern mouth of the river and Coleroon Point, and vessels should not close this part of the coast at night nearer than a distance of 4 miles, which, from a distance of 10 miles southward of, to abreast, the point, will give a depth of 20 fathoms, but northward of the point only 10 fathoms will be found at the same distance.

Vessels approaching Porto Novo from the southward should keep outside the 10-fathom contour line until Porto Novo flagstaff bears 280° , when the anchorage may be steered for.

Town.—An English settlement was established at Porto Novo in 1683, and for some time the place had a considerable trade which has since declined; in 1901, the population was 13,712. It is a depot for salt, and a remarkable description of mat is made from wild pineapple leaves.

Communications.—The British India Steam Navigation Co. have a service of steamers, and there is railway communication to the southward with Negapatam and to the northward with Madras; telegraphic communication with all parts.

Supplies.—Small supplies of provisions may be obtained.

Storm and weather signals are shown at Porto Novo.

Cuddalore, the principal port and capital of South Arcot District, is on the backwater formed by the confluent estuaries of Gadilam and Paravanur Rivers, and about 13 miles northward of Porto Novo; the coast between being low, with occasional sandhills, appearing from the offing like small islands.

Cuddalore Flagstaff, on a sand hill near the coast and about 800 yards northward of Gadilam River entrance, is most conspicuous, and has a white building close to and a church southward of it. About 2 miles northward of the town are the ruins of Fort St. David, the south end of which is visible from seaward through a gap in the casuarinas, and a small white pillar on a sandhill near the fort marks the northern limit of the port.

Gadilam River Bar has about 3 feet over it at low water, spring tides, and cargo boats discharge at a jetty up the river near the customhouse. Vessels of 200 tons have occasionally entered the river for repairs, mud docks being cut by the natives.

Light.—From a tower surmounting a square house, the whole 34 feet in height and painted white, is exhibited at an elevation of 65 feet above high water a group occulting white light, visible 12 miles. (For details see Light List.)

Storm and weather signals are shown at Cuddalore.

Anchorage may be obtained in 5 or 6 fathoms water, with Cuddalore flagstaff bearing 292° ; this is the most convenient anchorage for communicating with the shore.

Town.—The town is made up of several different quarters, of which Cuddalore New Town, noted for its ancient Siva temple, contains the principal public offices and European bungalows, picturesquely situated among fine trees on the four sides of a large open plain. Cuddalore Old Town is the seaport and chief trading center of the district.

Two rivers, the Ponnaiyar and the Gadilam, liable to heavy floods, pass through the town, which also contains the chief public offices and courts, an Anglican and a Roman Catholic Church, besides the customs and marine establishments. In 1911 its population was 56,574.

Communication.—Steamers of the British India Steam Navigation Co., running between Madras, Singapore, and Rangoon, call weekly, and those between Bombay and Calcutta fortnightly, and coasting steamers call periodically, also foreign vessels, to load with ground nuts. It is connected by rail with Porto Novo to the south and Madras to the north, the station being in the New Town; there is also telegraphic communication.

Coal and supplies.—A large quantity of coal is kept in stock for the South Indian Railway, but the authorities do not undertake to supply vessels except in case of necessity.

Bread, meat, poultry, vegetables, and fruit are cheap and procurable in any quantity. A part of the town is supplied with filtered water from a reservoir and fresh water can be supplied to shipping.

Hospital.—There is a municipal hospital, and also dispensaries.

Trade.—Ground nuts form the chief article of export, and others are oils, seeds, fodders and cattle food, yarns and textile fabrics, rice, indigo, and hides; the principal imports are areca nuts, pepper, coal, timber, spices, sugar, and European stores and provisions.

Climate.—The town is said to be healthy, and elephantiasis, once frequent, is disappearing. The average rainfall is 45.5 inches, of which 37.7 inches fall from August to December.

Pondicherri, the chief settlement of the French possessions in India and residence of the governor, is situated 13 miles northward of Cuddalore.

The land northward and at the back of Pondicherri Town is from 150 to 240 feet higher than that in the vicinity of Negapatam or Madras, and the cathedral and a high chimney of a factory which is situated $1\frac{1}{4}$ miles west-southwestward of the lighthouse, all serve to point out the place.

At times there is almost a total absence of surf on the coast, but landing on the beach should not be attempted in ships' boats. The small river which flows through the town admits native craft only.

Lights.—A fixed white light is exhibited, at an elevation of 89 feet above high water, from a masonry tower 49 feet in height, situated in the square near the beach. It should be visible 12 miles.

From a mast surmounting a small cabin on the end of the landing pier a fixed red light is exhibited, at an elevation of 31 feet above high water, and should be visible 2 miles.

When the surf is heavy, and approach to the pier prohibited, a fixed green light is exhibited 26 feet above high water, which should be seen about 3 miles.

Pier.—An iron screw pile pier for landing and discharging cargo, and at which ship's boats can land during the fine season, extends about 1,090 feet seaward from near the lighthouse.

It is connected by rail with the town railway station, and cars are unloaded on the pier and on the adjacent foreshore.

Signal stations.—Both the town flagstaff and the flagstaff at the port office are signal stations, with which communications may be made by the International Code.

Signals.—A blue flag hoisted at the port flagstaff indicates that, in consequence of the surf, communication with the shore is prohibited; and the same flag hoisted above the crane indicates that landing at the pier is forbidden, when communication can only be made by surf boats (chelingues).

Port regulations.—The local signals and the regulations of the port are delivered to merchant vessels immediately on arrival, and the directions therein should be strictly complied with.

In case of a vessel not answering signals made to her from the port, attention is drawn by guns being fired. The signal for a boat is answered by a blue pennant at the port office.

Vessels are not allowed to make fast to any part of the pier.

Quarantine.—The quarantine regulations are somewhat strict for vessels direct to or from Europe, and no communication is allowed with the shore, or with any vessel or boat in the roadstead, until pratique has been granted, unless the vessel arriving is in danger, when other vessels are bound to send assistance, whether pratique has been granted or not.

Anchorage.—The general anchorage is in from 6 to 7 fathoms water, with the lighthouse bearing 290° , distant 1 mile, but from October to December, when bad weather may be expected, it is desirable to anchor about $\frac{1}{2}$ mile farther out, in depths of from 8 to 9 fathoms. A long scope of cable is recommended, and precautions against bad weather should always be taken.

Directions.—During the northeast monsoon a sailing vessel from the southward should work northward near the middle of the Bay of Bengal until the land can be made in about latitude $12^{\circ} 30'$ north, and thence run down the coast to Pondicherri, keeping in depths of from 12 to 15 fathoms. After mid-February the route is direct after rounding Ceylon. As the gales on this coast generally commence from northwest, vessels are enabled to get away from Pondicherri to the southeastward and return when the gale is over.

During the southwest monsoon, from the southward, sailing vessels should make the coast in the vicinity of Karikal or Tranquebar, and bear in mind that the current sets northward.

Tides.—It is high water, full and change, at Pondicherri at 8h. 25m.; springs rise $3\frac{1}{2}$ feet, neaps $2\frac{1}{4}$ feet.

Town.—The town, which presents a picturesque appearance, is divided into two parts, White Town and Black Town, separated from one another by a canal. White Town, with its streets built at right angles to each other, and shaded by avenues of trees, possesses many fine buildings: the principal public ones are Government house, two pagodas, the new bazaar, the clock tower, the barracks, the military hospital, the town hall, and the parish church, which, standing about 400 yards southward of the lighthouse, has two square towers with a cupola, and is conspicuous.

Population.—The population of the whole district of Pondicherri, including Karikal, in 1913, was 276,198.

Communication.—Steamers of the British India Steam Navigation Co. between Madras and Negapatam have a weekly, and those

between Bombay and Calcutta a fortnightly, service, and the Asiatic Co. and the Messageries Maritimes steamers call regularly at Pondicherry. Other companies, generally the Clan and City Lines, send steamers occasionally when required.

A few Indian sailing ships trade between Pondicherry, Karikal, and other ports on the Coromandel Coast.

Pondicherry has railway and telegraphic communication, a branch railway connecting at Villapuram with the Indian system.

Coal and supplies.—About 1,500 tons of coal are kept in stock and about 4,000 tons imported annually. About 400 tons could be put on board in 24 hours, but northeast winds impede coaling. There are 100 lighters holding about 2 tons each.

Fresh provisions, meat, poultry, game, fruit, vegetables, and eggs are plentiful, but expensive; drinking water is supplied in barrels.

The Muttrapoliem waterworks scheme being completed, a good supply of water to all parts of the town is ensured.

The town and houses are lighted by electricity.

Hospital.—Seamen are admitted to the colonial hospital.

Landing in ships' boats should not be attempted except at the pier in fine weather.

Trade.—The principal exports are ground and other oil nuts, rice, oilcakes, guinees (blue cotton cloths), and dried fish; and the imports, wines, brandy, dry grains and pulse, coriander seeds, and areca nuts.

Winds.—The southwest monsoon blows from about the middle of March to October, and the northeast from about the middle of October until March. Gales are not uncommon from October to December, both inclusive; they generally commence from northwest, and veer northward and eastward; after a gale southeasterly wind and fine weather usually prevails.

In January the sky is mostly clear, and the northeast wind fresh; the wind is more eastward during February and until the middle of March, at the end of which month it blows from southeast by day and southwest at night.

During the southwest monsoon the land wind is sometimes very strong and gusty, and changes rapidly in direction and force, but seldom lasts long.

Coast.—From Pondicherry the coast trends in a north-northeast direction for 9 miles, and then a little more easterly for 29 miles to Palar River mouth. The country is low and sandy, except the slight elevation already mentioned northward of Pondicherry, and some hills, from 240 to 650 feet, from 6 to 16 miles northwestward of Allamparwa River; these can be seen at a distance of 5 or 6 miles from the coast.

Allamparwa River mouth, which is barred, is situated 22 miles northward of Pondicherry, and a thick grove of lofty casuarina trees

northward of it is dark and conspicuous. A thick wood of palmyras trees stands at the back of the sand hills about 9 miles northward of Allamparwa.

Depths offshore.—The coast bank between Pondicherri and Palar River mouth has depths of 5 fathoms at the distance of about $\frac{1}{2}$ mile from the beach.

Chengalpat (Chingleput) District, northward of Pondicherri, notwithstanding its extent of coast line, which is about 80 miles, has, besides Madras, only three ports, Covelong, Ennore, and Pulicat, which are open roadsteads; boat traffic is carried on with Madras by means of a canal and backwater.

Palar River is a considerable stream, draining a large tract of country and receiving many tributaries, but, like other rivers on this coast, has a bar at its entrance which completely closes in the dry season; a canal connects the river with Madras. A plantation of lofty coconut trees stands on the north side of the river.

Breakers extend about 600 yards, and a spit, on which the depth is $2\frac{3}{4}$ fathoms, is nearly 1 mile from Palar River mouth.

Sadras, at one time famous for its fine muslin woven in looms, but from which the trade has completely fallen away, was in former years a flourishing Dutch settlement; it is situated about 3 miles northward of Palar River entrance. The village, which lies low, is almost completely hidden from seaward by trees; there is a ruined brick fort close to the shore, with a cemetery, which contains curious and elaborate tombs inside it; a few weavers still live in the village, which in 1901 had a population of 1,564.

Sadras Hills, the most conspicuous hills on this part of the coast, are 10 miles northwestward of Palar River entrance; the highest part of the range is 650 feet high, and close to it is Finger Peak, 500 feet high, with a temple on its summit, making it easily recognized. Tirumani Hill and Pataravakam Hill, 768 and 703 feet high and $5\frac{1}{4}$ miles west-northwestward and $6\frac{1}{4}$ miles north-northwestward, respectively, from Finger Peak, with smaller hills clustered round them, are also conspicuous.

Coast.—From Sadras the coast trends in a north-northeast direction for nearly 17 miles to Covelong Point, northward of which it recedes slightly, and then continues for about 18 miles to the northward to Madras. Between Sadras and Covelong Point the coast should not be approached to a less depth than 15 fathoms, as there are several rocky patches near it, especially northward of Tripalur Reef.

Mahabalipur (Seven Pagodas) is a rocky point 9 miles northward of Palar River entrance; the pagoda from which the light was formerly exhibited is the only one visible from seaward.

Light.—A masonry tower, 84 feet in height, on a conspicuous rock, exhibits, at an elevation of 137 feet above high water, a group flashing white light visible 18 miles. (For details see Light List.)

Tripalur Reef is a rocky ledge extending $\frac{3}{4}$ mile off Mahabalipur; the inshore ends of the ledge are awash, and the outer edge has a depth of $4\frac{1}{2}$ fathoms over it, with $6\frac{1}{2}$ fathoms close-to.

Rockingham Patches have a least depth of $2\frac{1}{2}$ fathoms on a patch situated $4\frac{1}{2}$ miles northeastward of Mahabalipur Lighthouse and 1 mile offshore; the shoal patch is on the outer edge of uneven ground 1 mile in extent, with depths of from 4 to 5 fathoms and $5\frac{1}{2}$ fathoms between it and the shore.

Two rocky heads, having $3\frac{3}{4}$ fathoms water over them, lie $\frac{3}{4}$ mile northeast and $1\frac{1}{4}$ miles south-southwest of the shoalest spot.

Tiruporur Hill, 148 feet high, with its summit crowned by a temple, is situated $6\frac{1}{2}$ miles northward of Mahabalipur.

Covelong, one of the earliest European settlements, but now of no importance, is situated 11 miles northward of Mahabalipur and contains a few European bungalows on the south bank of the river, which flows into the sea; backwaters or the Buckingham Canal connect Covelong with Palar River to the southward and with Madras to the northward. A Roman Catholic church and the bungalows mentioned above, being almost entirely hidden by trees, are not easily made out. In 1901 the population was 1,921.

Covelong Point, extending from the coast just southward of Covelong, is scarcely distinguishable from it, except when close-to.

Anchorage.—There is open anchorage in a depth of 7 fathoms with Covelong bearing 270° distant about 1 mile.

Landing.—Rocks awash extend about 600 yards northeastward of Covelong Point, and in the southwest monsoon landing may be effected near them.

From Covelong the coast trends about north for nearly 18 miles to Madras Harbor and is low throughout.

Ottirakam Hills, the highest, sharp, conspicuous, and 548 feet high, is situated $8\frac{1}{2}$ miles westward of Covelong Point; it is near the southern end of a low range of hills stretching north and south. Pallavaram Hills, double-peaked, with a temple on a summit 499 feet high, and St. Thomas Mount, crowned with white buildings, 252 feet high, are conspicuous.

Madras, the capital of the presidency of Madras and the seat of the government, is situated close to the sea on a low and sandy coast exposed to a heavy surf and including a number of suburban tracts and villages stretches nearly 9 miles along the coast and runs $3\frac{1}{2}$ miles inland. Notwithstanding natural disadvantages, owing to its railway communication and artificial harbor, it ranks third among the ports of India.

Aspect.—The approach from sea presents a low sandy coast studded with casuarina trees to the north and south, with several handsome and conspicuous buildings as a center. Fort St. George, in the middle of which stands the original fort, built in 1639, is a handsome fortress on the coast nearly 1 mile southward of the harbor; here also is St. Mary's, the earliest English church in India. The other buildings conspicuous from seaward are the native college, senate house, museum, St. Andrew's Church, law courts, and post office.

The Cooum, a small and sluggish river, flows through the city and enters the sea southward of Fort St. George; its mouth is closed during the cold season. Immediately facing the harbor are the port office, consular agencies, and the offices of the principal merchants and shipping firms.

Madras Harbor, originally formed by two breakwaters, with an entrance to the eastward, between their heads, which is now closed, consists of a southern breakwater, about 2,600 feet long in an east-southeast direction, turning to the north-northeast, with an outward curve to the eastward for a further distance of about 3,000 feet, to the root of a spur breakwater, which, following a similar direction, has a length of about 1,350 feet.

A short arm, about 300 feet, extends in a west-northwest direction from the root of the spur pier, and the north breakwater extends toward its head in an east-southeast direction parallel to the south breakwater, leaving between them an opening to the north-northeastward, about 400 feet in width.

The harbor accommodates from 13 to 14 ships of deep draft, besides smaller vessels.

The coast southward of the harbor is advancing seawards, whilst northward it is receding, except where protected by stones. The harbor was redredged in 1893, but considerable shoaling has taken place southward of the harbor since the date of the last survey, and the depths shown on the plan should not be relied on.

Depths.—There are depths of 6 fathoms in the entrance between the breakwater heads, and about the same over an area extending 400 yards westward of the eastern part of the breakwater, from which they gradually shoal toward the shore. Vessels of any draft can enter the harbor at all times of tide.

Lights.—The main tower of the law courts, an octagonal tower of brick and stone, with gilded dome, 190 feet in height, situated on the esplanade, about $\frac{1}{4}$ mile northward of Fort St. George, exhibits, at an elevation of 166 feet above high water, a group flashing white light, visible 20 miles. (For details see Light List.)

North Arm.—From a conical column of cement, 26 feet in height, and situated on the outer end of the North Arm, an alternating

occuluting light is exhibited, at an elevation of 36 feet above high water, visible 10 miles. (For details see Light List.)

Breakwater heads.—On each of the breakwater heads is a cylindrical column of cement, 26 feet in height, exhibiting, at an elevation of 35 feet above high water, a fixed red light, visible 6 miles.

Pier.—An iron screw pile pier, 1,000 feet in length, with a T-shaped head, projects from the shore about midway between the inner end of the breakwaters, and at its extremity is a depth of $3\frac{1}{2}$ fathoms. Vessels are not allowed to lie alongside this pier, which is reserved for boats with cargo or passengers. Ships' boats use the pier in safety except in bad weather, when a masula boat should be employed.

Railway lines are laid along the pier for the conveyance of cargo, and steam cranes facilitate the discharging of cargo boats. There are 21 cranes on the pier (which can only be used for lighters) to lift from $1\frac{1}{2}$ to 20 tons; and 10 other cranes to unload machinery, heavy packages, etc.

Regulations.—When the harbor is full, steamers are admitted in order of arrival, on departures taking place.

No vessel is allowed to enter or leave Madras Harbor without having a pilot or the harbor master on board, unless authority to that effect has been given in writing by the conservator of the port. Vessels about to leave hoist international code flag N at the fore, and if about to enter, the same code flag F. Only one vessel may leave or enter the harbor at the same time.

Large sailing vessels are only admitted into the harbor under very special circumstances and in settled weather.

No vessel may enter or leave the harbor between 6 p. m. and 6 a. m. without special authority.

International Code flag H at the main is the signal for a doctor; flag D for an accommodation boat; the union jack under the red ensign, or at night three white lights vertical, at the peak, for the police boat.

Pilots.—Vessels arriving at Madras should find a pilot in the vicinity of the end of the North Arm.

Buoys.—Two conical buoys, painted red, are moored northward of the harbor, for the use of vessels discharging cargo of a nature not permitted to be discharged inside. The southern buoy is 500 yards, and the northern buoy 1,200 yards northward of the north breakwater; both buoys are about 650 yards offshore and in a depth of 5 fathoms.

A buoy is moored 800 yards southward of the southeast elbow of the southern breakwater, but it is not used for purposes of navigation.

Anchorage.—Madras Road is open except to offshore winds, and there is generally a swell from seaward, causing vessels to labor or roll considerably. Large vessels anchor in a depth of $9\frac{1}{2}$ fathoms, nearly 2 miles from the shore, with the lighthouse, the main tower of the law courts, bearing southward of 270° , and should ride with at least 60 fathoms of cable out. Sailing vessels, except coasting craft, anchor in not less than 9 fathoms.

The bottom in many places is stiff mud, from which it is difficult to extricate the anchors. Vessels should not come into a less depth than $9\frac{1}{2}$ fathoms at night; a second anchor should be ready for letting go, and the anchors should be buoyed.

During the bad weather season it is necessary for a sailing vessel to anchor well out, and be ready to proceed to sea, for the wind in cyclonic storms generally commences from northwest, with which an offing can be gained before it shifts to northeast and east, when it would be impossible to get away. If a vessel weighs or slips and runs seaward at the approach of a gale little danger is to be apprehended, but vessels remaining at anchor are likely to be driven on shore.

All vessels shall strike their yards and topmasts when required to do so by the conservator of the port, by signal or otherwise.

The north and south limits of the port are marked by boundary pillars, and it extends eastward to a depth of 10 fathoms. A vessel anchored in more than 9 fathoms is liable to extra boat hire.

Prohibited anchorage.—Anchoring is prohibited in any part of Madras Roadstead southward of the line of the lighthouse bearing 270° , in order to prevent injury to the submarine telegraph cable.

Ballast.—No ballast may be thrown overboard off Madras in a less depth than 12 fathoms.

Moorings are laid down in the harbor and vessels are moored, head and stern, to buoys without anchoring, bows toward the middle of the harbor.

The buoys are placed about 600 feet apart, excepting one pair for very long steam vessels, which are 800 feet apart.

Moorings are reserved for vessels with petroleum near the middle of the northern breakwater.

Surf.—The surf at Madras, north and south of the harbor, breaks 300 feet from the beach in fine, but 450 feet in squally, weather. During gales from the eastward it is said to break at a distance of 1,000 feet from the beach.

There are two lines of surf between which it is possible for a boat to remain without crossing either; the outer of these, or male surf, is the most formidable. With the wind offshore the surf is often very high, but then there is only one slow heavy roller. In ordinary

weather the surf wave is 2 to 4 feet high, in rough weather 6 feet, and during a gale 12 to 14 feet.

Masula boats, used for landing, are made of planks sewn together with coconut fiber.

Directions.—From February to September sailing vessels bound to Madras should make the land to the southward, sighting Sadras Hills, on account of the strong northerly current then prevalent.

From September to January the land should be made to the northward, Kettle Bottom Hill in latitude $13^{\circ} 26'$ north, the southernmost hill of Pulicat Range, and about 33 miles westward of Pulicat Light-house by day, or at night Pulicat Light, are then good marks. From the northward, Madras Main Light (group flashing) should not be brought to bear southward of 208° , using the lead.

Cyclones at Madras usually commence with the wind from north-northeast to north-northwest, and the wind changes in direction eastward or westward as the port is in the right or left hand semicircle of the storm.

Sailing vessels should have good sails bent and topsails and courses close reefed. The ground swell has always a tendency to cast a vessel inshore on parting or slipping, and this being dangerous, precaution should be taken to have a spring on the cable to cant the ship's head seaward.

With a northwest wind at Madras, the center of the storm bears about east-northeast to east. A vessel should therefore stand south-southeast (not southeast) until in the latitude of Pondicherri or Cuddalore, and then heave-to on the port tack, thus obtaining a clear drift, at first eastward, and then, with the rapid shifting of the wind, westward, back to port. But to carry out these directions a vessel must leave early in the storm; in fact, at once, on seeing or hearing the signal that a storm is approaching, as every hour is of importance.

Vessels in ballast, or discharging cargo, such as iron, timber, etc., should, on the approach of a gale, shift into 11 or 12 fathoms water, with two anchors down, and as much cable as possible out. The upper masts and yards must be struck, and the cargo secured from shifting. This method of riding out a cyclonic storm has been successfully accomplished.

Storm and weather signals are shown at Madras.

Madras receives, at about 1 p. m. daily, a telegram giving weather conditions in Bay of Bengal, which will be transmitted to ships.

General directions.—On the warning signal being hoisted masters of vessels at anchor within the limits of the port are required to attend to the following directions:

(a) Not to be absent from their respective vessels between sunset and sunrise.

(b) To keep their respective vessels prepared in every respect to proceed to sea at short notice.

(c) To proceed to sea without waiting for instructions to do so should they deem such a course prudent.

On the danger signal being hoisted, the master of each vessel will take such measures for securing the safety of his vessel as he may consider requisite; no further instructions on that point will be furnished by the port authorities.

Vessels inside the harbor are usually sent to sea before the full development of a storm, and pilots take the vessels out. If not practicable to supply pilots, masters will be instructed by signal or message to take their own vessels to sea.

Occasions may arise in which it would be impossible for vessels to go out of harbor; one occurred in 1896, when three or four vessels rode out a cyclonic storm inside the harbor. Of these vessels, one, through not taking proper precautions, parted and went ashore, but afterwards got off undamaged. The failure to send vessels to sea on this occasion was due to the ordinary squally northeast monsoon weather developing into a cyclonic storm during the night, when to have sent vessels to sea would have been more dangerous than leaving them at their moorings.

The vessels which rode out the storm dropped one anchor and eased off a few fathoms of their bow lines, tending their stern lines as required.

If a vessel in the harbor breaks adrift during the strength of a severe cyclonic storm, the safest course is to beach her, both in the interests of those on board and for the welfare of the harbor.

Tides.—It is high water, full and change, at Madras at 9h. 1m.; springs rise $3\frac{1}{2}$ feet; neaps rise $2\frac{1}{2}$ feet. The tides are subject to diurnal inequality, which may accelerate or retard the times of high and low water and increase or diminish the rise by, at times, as much as 1 foot. In October, November, and December the mean level of the sea is 1 foot higher than from February to May.

City.—Madras city, the capital of Madras presidency and the third largest city in the Indian empire, is built, in a straggling fashion, on a strip of land 9 miles long, from 2 to 4 miles wide, and covers an area of 27 square miles; the land is low lying, almost dead level, being about 22 feet above sea level, and intersected by the Cooum and Adyar, two sluggish streams, which, except in the rains, form salt lagoons, separated from the sea by narrow ridges of sand.

The principal European quarters are in Egmore, Chetpet, Kilpauk, Nungambakam, Teynamfet, and on the strip of land on the north bank of the Adyar River.

George Town, formerly Black Town, the native quarter and also the commercial center of the city, lies immediately behind the harbor, and is more thickly populated than any other part; in the center is the island, an open space which is the parade and recreation ground, besides which are the People's and Napier Parks. The public buildings are more than usually handsome, but, being somewhat scattered over the city, they have not such a striking effect; there are also several statues and fine churches, besides mosques and Hindu temples.

Population.—In 1911 the population was 518,660, of which 4,228 were Europeans.

The United States is represented by a consul and vice consul.

Communication.—There is weekly communication by steamers of the British India Co. with Pondicherry, Cuddalore, Negapatam, and Rangoon and a fortnightly service to Bombay, Calcutta, and the Straits.

The Madras Railway system has three sections: The East Coast line to Calcutta, the Northwest line to Bombay, and the Southwest line to the west coast; the Rayapuram terminus is the station for the first and the Central Station for the others.

The South Indian Railway runs to Tuticorin, from whence steamers ply to Colombo; the terminus of this line is at Egmore, but both the Madras and South Indian Railways have a joint station on the beach, opposite the harbor, for the convenience of shipping.

The Buckingham Canal affords transit from places along the coast between South Arcot District, in the south, and Guntur District, in the north.

Two submarine cables connect Madras with Penang, one being via Pulo Weh; there is telegraphic communication with all parts.

A cheap and speedy service of electric cars is in operation in the most crowded parts of the city, and there is a telephone exchange and an hourly postal delivery; the corporation maintains 187 miles of metaled roads.

Coal and supplies.—About 17,000 tons of coal are kept in stock and about 200,000 tons imported annually; coaling is carried on by both bags and baskets, and from 300 to 450 tons can be put on board in 24 hours. About 1,400 tons of patent fuel is stocked, and 2,000 tons imported annually; 1,400 tons can be put on board in 24 hours.

Supplies of fresh meat, vegetables, and bread can be procured, and the town is supplied with water from Red Hill Lake Reservoir, from which it brought first by open channel and then by pipes, and shipping receive it from tank boats.

Repairs.—Large repairs could be undertaken by three firms; there is one steam hammer of 1½ tons and several smaller ones.

There are two 33-ton steam cranes, one of 15-ton and one of 10-ton capacity, besides numerous hand cranes capable of lifting from 1 ton to 10 tons.

Wharves.—There are three wharves, two of which have depths alongside of 28 feet, and one of 30 feet at low water; two of these wharves have direct railway communication and are used for passenger traffic.

A new quay, 3,000 feet long, is in progress.

Hospitals.—There are nine hospitals and five dispensaries, and seamen are received at the general hospital.

Sailors' home.—There is a small sailors' home at Madras.

Quarantine is not enforced at Madras unless a vessel has infectious or contagious disease on board.

Time signals.—The semaphore at the port-office flagstaff, 103 feet above high water, is dropped at 1h. 0m. 0s. Indian standard time, or the meridian of $82^{\circ} 30'$ east, corresponding to 19h. 30m. 0s. Greenwich mean time. When the semaphore drops incorrectly, the International Code signal M Q T is hoisted immediately, and kept flying for half an hour; in this case the semaphore is dropped again at 2h. 0m. 0s. Indian standard time, or 20h. 30m. 0s. Greenwich mean time.

In addition to the above signal, a gun is fired by electricity from a battery near the lighthouse at noon and at 8h. 0m. 0s. p. m. Indian standard time.

Madras Observatory is situated about $2\frac{3}{4}$ miles west-southward of the Law Courts Lighthouse. To this observatory all Indian longitudes are referred, and it is the point of departure of the trigonometrical survey.

Trade.—The arts of Madras are silk and cotton weaving, silver work and embroidery; there are weaving mills, cement and tile works, iron foundries, cigar factories, and aluminum utensils are manufactured.

The chief foreign exports are hides, skins, Indian piece goods, indigo, and raw cotton; and imports, European piece goods, twists, yarn, iron, steel, machinery, railway plant, and kerosene oil.

Radio station.—A radio station, open to the general public at all hours, has been established at Madras; call letters V W M.

Climate.—The climate of Madras has been described with some accuracy as three months hot and nine months hotter. The cooler months are never cold, the mean temperature of December and January being 76° , but the summer heat is not so great as that of northern India; the mean temperature for the year is 81.8° .

The annual rainfall for 85 years averages 49 inches, the greater part of which fall during the northeast monsoon, from October to December.

Wind, weather, and current.—The following table of wind, weather, and current prevalent on the Coromandel Coast applies particularly to the vicinity of Madras:

Months.	Wind.	Force.	Current.	Rates.	Remarks.
January.....	Northeast to east - northeast, veering east.	Steady and fresh.	Southwesterly or northerly.	1 to 1½ miles.	Currents irregular.
February.....	Northeast, veering to southeast and south.	Light.....	Northerly parallel to coast.	1½ miles...	
March and April	South-south-east to south-southwest, decreasing at sunset, succeeded by southwest to west-northwest.	Strong.....	...do.....	1 to 3 miles at times.	In April, squalls occasionally from northwest.
May.....	South to southwest, veering toward the land at night.	Not strong nor steady.	...do.....	1 to 2 miles.	The most dangerous month in the bay except October. Barometer should be watched, especially if north-northwest wind sets in veering northward. At night (early part) squalls off the land from northwest.
June.....	South-southwest and west.	Steady and increasing.	Variable, sometimes, southward.	Weak.....	Weather fairly settled near Madras. If wind veers northward, watch barometer.
July and August	South-southwest to west, with rain and overcast sky.	Strong.....	Southwesterly or against the wind.	2 to 3 miles at times.	By keeping inshore good passages have been made from north to south.
September.....	South-southwest to west.	Decreasing in strength.	South and south-southwest.	Strong....	Northeast winds sometimes for 2 or 3 days together.
October.....	Variable..... Northeast toward end of month.	Light..... At times light, at others strong, with rain and cloudy weather.	Southerly along the coast.	...do.....	Weather uncertain, cyclonic storms likely. Very low barometer is not always accompanied by strong winds. A stormy sky should be heeded.
November and December.	Northeast.....	Strong and steady.	Southwesterly, and southerly along the coast.	Strong, 2 to 4 miles.	Unsettled till early in December. Caution necessary. Cyclonic storms often occur in November and even in early December.

Coast.—About 3 miles northward of Madras plantations of casuarina trees commence and extend to Ennore. There are several fishing villages on the coast, and a noticeable white native temple is situated about 4½ miles northward of Madras.

Caution.—The use of the lead is necessary when navigating on the coast between Madras and Kalingapatam, especially at night, as the currents are very variable, both in rate and direction, and sometimes set toward the land.

Ennore Village, properly Kattivakkam, once a favorite resort for Europeans from Madras, from which it is distant 9 miles, is now, owing to the prevalence of virulent malarial fever, only a fishing village and center of salt manufacture. The bungalows once occupied

occupy a strip of land between the sea and the backwater. In 1901 the population was 3,192.

The sand dunes along the coast, which cover an area of about 20,000 acres, have all been converted into casuarina plantations, which has materially changed the physical aspect of the long stretches of coast in this vicinity.

Ennore is situated at the mouth of an extensive backwater, which finds its way into the sea, and is connected by canal and road with Madras. Vessels bound to Ennore enter and clear at Madras.

Ennore Beacon, a white obelisk situated on a sand pit on the southern side of Ennore backwater entrance, is 54 feet high, and in the forenoon, with the sun shining on it, is conspicuous; in the afternoon it is not easily distinguished, but the gap in the trees formed by the backwater entrance is then noticeable.

Anchorage.—There is anchorage off Ennore in depths of from $6\frac{1}{2}$ to 7 fathoms, about 1 mile offshore, with Ennore Beacon bearing 309° .

Coast.—Between Ennore and Pulicat, a distance of $12\frac{1}{2}$ miles, the coast protrudes slightly, and is low, sandy, and backed by an extensive plain, which is densely wooded near the beach.

Ennore Shoal, a sand bank, with depths less than 3 fathoms, and with a least depth of 3 feet on it, projects northeastward $1\frac{1}{4}$ miles from the coast, $2\frac{1}{2}$ miles northward of Ennore Beacon.

Pulicat Shoals consist of a chain of hard sandy patches having over them depths of from $2\frac{1}{2}$ to $3\frac{1}{2}$ fathoms. The southern patch, on which there is a depth of $2\frac{3}{4}$ fathoms, lies $6\frac{1}{2}$ miles north-northeastward from Ennore Beacon, and nearly 2 miles from the land; the northern patch, which has $3\frac{1}{4}$ fathoms on it, is $9\frac{1}{2}$ miles in the same direction from that beacon, and $3\frac{1}{4}$ miles off the land, the shoals lying between these patches.

About $\frac{3}{4}$ mile northward of the northern patch of Pulicat shoals is a patch of $4\frac{1}{2}$ fathoms, and $1\frac{1}{4}$ miles farther north a patch of 5 fathoms.

There are depths of from 4 to 5 fathoms between the northern end of Ennore Shoal and the southern patch of Pulicat Shoals, but this passage is not recommended.

In 1912 these shoals were reported extending to the eastward.

Clearing marks.—Kettlebottom Hill, in line with Pulicat Lighthouse, bearing 270° , leads northward of Pulicat Shoals and patches of less than 5 fathoms; and Madras Principal Lighthouse bearing westward of 208° leads eastward of Pulicat and Ennore Shoals.

Caution.—In the vicinity of these shoals the lead should be used and the water not shoaled to less than 15 fathoms.

Tides.—It is high water, full and change, at Pulicat Shoals at 9h. 25m.; springs rise $2\frac{1}{4}$ feet.

Current.—The current in the vicinity of Pulicat Shoals is feeble and runs parallel to the coast.

Pulicat, a town on the southern extreme of an island at the south end of Pulicat Lake, and the earliest Dutch settlement in India, came into English possession in 1795. Traces of the Dutch occupation are found in the ruins of a fort and in a cemetery. The town, which can be seen from seaward, was formerly a center of trade with Penang and the Straits Settlements, and was used as a sanatorium for Madras, but its use was discontinued on account of malarial fever and it is now comparatively deserted. There is a high conspicuous monument just northward of the lighthouse. Pulicat is generally considered the southern limit where the Telugu language is spoken. The population was 5,448 in 1901.

Light.—From a masonry column, 57 feet in height, painted in black and white horizontal bands and situated near the beach at Pulicat, a flashing white light is exhibited at an elevation of 68 feet above high water, visible 14 miles. (For details see Light List.)

Directions.—From the southward pass outside Pulicat Shoals, using the lead and not shoaling to a less depth than 15 fathoms, and keeping Madras Main Lighthouse or Light bearing 208° , or westward of that bearing, until Pulicat Light bears 270° , when steer for it, and anchor with the light on that bearing in $6\frac{1}{2}$ to 7 fathoms about $2\frac{1}{2}$ miles off-shore.

Trade.—The only trade is the export of woven cloth, dried fish, and prawns.

Mountains.—About 30 miles inland is a range known as Pulicat or Nagari Hills, the southern end of which is Kettlebottom, a remarkable flat-topped hill, bearing 270° from Pulicat Lighthouse.

False Kettlebottom is another flat-topped hill lying nearly 4 miles northeastward of Kettlebottom, for which it might be mistaken from the northeastward.

Kambakam Durgam, the highest part, 2,546 feet in height, is situated about the middle of the range $10\frac{1}{4}$ miles north-northeastward of Kettlebottom.

Nagiri Nose, a sharp peak, the upper part of which is crooked, 2,822 feet above high water, lies $10\frac{1}{2}$ miles west-southwestward of Kettlebottom, and, being 43 miles inland, is only seen from seaward in clear weather.

Pulicat Lake, a salt-water lagoon about 37 miles long and from 3 to 11 miles broad, forms part of the inland water communication of this part of the coast; it is separated from the sea by a long, narrow sandy island and by the strip of sand on which the town stands.

It contains several islands, on which lime is made from shells, is connected with the sea by openings north of Pulicat and its other parts, and is influenced by the tide; it is seldom more than 5 feet

deep in the dry season. It communicates at its southern end with Buckingham Canal.

Nellore District has several ports, or open roadsteads, where cargo is shipped, and the custom authorities have arranged that the north limit of one forms the south limit of the next; its coast line is about 110 miles in length. None of these ports are of much importance; the principal ones are, commencing from the south, Armagon, Kistnapatam, Ramapatnam, and Iskapalli.

From Pulicat Lighthouse the coast is low and nearly straight in a north-northwest direction for 13 miles, and then turns to the northward for nearly 10 miles to Point Pudi, forming a shallow bight with soundings of 5 to 6 fathoms about $\frac{1}{2}$ mile from the beach.

The principal entrance to Pulicat Lake is 2 miles northward of Pulicat Lighthouse, and on the coast for 11 miles northward of the entrance are casuarina plantations, after which the trees are few until about a mile southward of Point Pudi, where there is a conspicuous clump of coconut palms on a sand hill about 80 feet high.

Beacon.—A wooden beacon, 35 feet above high water, is situated $\frac{1}{2}$ mile northward of Pulinjerikuppam Village, but is not conspicuous.

Point Pudi, a low sandy point with hillocks 15 feet high and clumps of palms in its vicinity, is about 22 miles northward of Pulicat Lighthouse.

Point Pudi Shoal, with depths of from 1 to $2\frac{3}{4}$ fathoms, over sand, extends about $2\frac{1}{4}$ miles southeastward of the point, off which the sea breaks in rough weather at the distance of 1 mile; the outer edge of this shoal, having depths of 4 fathoms, is distant $2\frac{1}{2}$ miles from the coast.

From Point Pudi the coast trends north-northwestward for about 21 miles to the mouth of Suvarnamukhi River and then turns northward for about 9 miles to the entrance to Vupatteru River; Armagon Lighthouse is situated about $7\frac{1}{2}$ miles north-northwestward of Point Pudi.

Armagon Light.—From a column 101 feet in height painted white, situated near Armagon or Monapalem Village, a group flashing white light is exhibited at an elevation of 97 feet above high water, visible 15 miles. (For details see Light List.)

Armagon Shoal extends from near Point Pudi, within the 5-fathom contour line, for about 14 miles northward, with depths over it of $1\frac{1}{4}$ to $4\frac{3}{4}$ fathoms; its southern extreme being about 2 miles north-northeastward of Point Pudi; the shoalest part, $1\frac{1}{4}$ fathoms, which sometimes breaks, is about 3 miles north-northeastward of Point Pudi, and the broadest part, about $2\frac{3}{4}$ miles, with 2 to 4 fathoms over it, is eastward of Armagon Lighthouse.

The eastern edge of the northern end of the shoal lies 6 miles from the coast, with the 10-fathom and 20-fathom contour lines 1 mile

and $2\frac{1}{2}$ miles farther eastward. Some detached patches of $4\frac{1}{2}$ and 5 fathoms lie off the north end of this shoal.

There is a channel $\frac{1}{2}$ miles wide leading into Blackwood Harbor between Point Pudi Sheal and Armagon Shoal, with depths of 4 to 6 fathoms; it should only be used by coasting craft.

Directions.—Armagon Lighthouse is the best landmark near Armagon Shoal, as Gudali Hill, about 13 miles northwestward of the lighthouse, a conspicuous flat-topped hill, 297 feet high, with a pagoda near its center is seldom visible from the outer part of Armagon Shoal.

In approaching this part of the coast, sighting the land must not be relied on, as it is often obscured by haze; and the current, though generally setting with the prevailing wind, sometimes reverses its direction; therefore the lead must be used and the depth not shoaled to less than 20 fathoms; the position should also be frequently fixed by astronomical observations.

Blackwood Harbor, lying between Armagon Shoal and the coast, is an area about 3 miles in width, east and west, and 10 miles in length, with depths of from 4 to 6 fathoms over sand and good-holding ground.

Anchorage may be obtained in 5 fathoms water, over a bottom of coarse sand, with Armagon Lighthouse bearing between 281° and 290° . A convenient position during the southwest monsoon is with Armagon Lighthouse bearing 259° , distant about $2\frac{3}{4}$ miles.

Directions.—Keep in a depth of not less than 12 fathoms until Armagon Lighthouse bears 206° , or Gudali Hill 259° , and then steer on the latter bearing for Gudali Hill, passing northward of Armagon Shoal in a depth of about 6 fathoms.

Dugarazupatnam, sometimes named Armagon, situated on an extensive backwater, the entrance to which is about 7 miles from Armagon Lighthouse, is a small village, the resort of salt makers, where there is a post office and travellers' bungalow; its population in 1901 was 2,388.

Kudur, another small village, is 2 miles northward. Both these villages are on the Buckingham Canal, and a considerable boat traffic passes through them in the southwest monsoon.

Beacon.—About $5\frac{1}{2}$ miles northward of Kudur, on a sandy spit and quite close to the beach, is a wooden beacon with a cross, but it is not readily seen till close-to. Inside the beacon is a shallow backwater, which runs northward, parallel to the coast for 3 miles.

Kottapatam.—About $1\frac{1}{2}$ miles northward of the beacon and about a mile inland is Kottapatam town, and in its vicinity there are two conspicuous clumps of casuarinas. Eastward of the town is an entrance to Suvarnamukhi River, which is very narrow and too shallow for boats.

Vupatteru or Kandleru River.—About $7\frac{1}{2}$ miles northward of the entrance to Suvarnamukhi River is the mouth of Vupatteru River leading to an extensive backwater; the entrance is fairly good, and can be safely used by native craft of light draft. Kistnapatam, the chief port of the town of Nellore, with which it is connected by road, is situated on the left bank of the river and close to the Buckingham Canal. The trade is chiefly in salt.

Anchorage.—Coasting vessels occasionally anchor outside the mouth of Vupatteru River in depths of from $5\frac{1}{2}$ to 6 fathoms, about 2 miles from the beach, but this anchorage is only safe during fine weather.

Coast.—The coast from Vupatteru River trends a little eastward of north for 6 miles and then north for 15 miles to the mouth of Penner River. For 3 miles northward of Vupatteru River the coast is low and sandy, with plantations of casuarina trees, then sand hills 30 to 60 feet high continue for about 3 miles to the point abreast Shallinger Shoal, whence to Penner River it is low and sandy, with a few casuarina clumps and other trees, but nothing conspicuous.

Shallinger Shoal, narrow, and with depths on it of $1\frac{1}{2}$ to $2\frac{1}{2}$ fathoms over it, extends northeastward about $2\frac{1}{2}$ miles from the coast about 8 miles northward of Vupatteru River Entrance; the 5-fathom contour line is about 3 miles offshore in this vicinity, and there is a depth of $4\frac{1}{2}$ fathoms at nearly that distance offshore.

The soundings outside the shoal are regular, and the coast may be safely approached to a depth of 8 fathoms.

Penner River, one of the largest in southern India, rises in Mysore, flows eastward through the Carnatic, and enters the Bay of Bengal 15 miles northeastward of Nellore Town; it is used for irrigation and is crossed by dams at Sangam and Nellore. Nellore, the chief town of the district, is situated on the right bank of the river, on rising ground, at 11 miles inland.

From the mouth to Nellore the river has an average width of $\frac{1}{2}$ mile, but it is so shallow that only native craft can enter, and it is liable to sudden freshets. The mouth of the river is not easily made out from seaward, as the river enters the sea behind a sandy point only a few feet above water.

Anchorage may be obtained off Penner River in fine weather and with offshore winds, in from 5 to 7 fathoms, over sand and mud, about $1\frac{1}{2}$ miles from the coast.

Communication.—There is a station at Nellore, on the Bezwada-Madras Railway.

Narsimhakonda Pagoda, on a hill 504 feet high westward of the town of Nellore and 17 miles inland, is painted white and sometimes visible from seaward between the bearings of 247° and 292° , but it is not very conspicuous.

Buckingham Canal, which connects Madras with the delta of the Kistna, passes along the coast at distances of a few hundred yards to 2 miles inland. It is largely used by native craft, and their masts or sails may generally be seen from seaward when northward of Penner River.

From the mouth of Penner River the coast trends in a north-north-west direction and is low and sandy, but the casuarina clumps are more continuous and the trees higher than southward of the river.

Iskapalli Village, situated 10 miles north-northwestward of the mouth of Penner River, has a flagstaff on the beach which shows over the trees. It is a seaport and customs station, and trade is carried on from the village by the Buckingham Canal.

Nishanbotu, 229 feet high, is the north end of a ridge which lies nearly 11 miles west-southwestward of Iskapalli.

Depths offshore.—About 2 miles southward of Iskapalli the 10-fathom contour line approaches the coast to $1\frac{1}{2}$ miles, and from this again draws off it, so that at Ramiapatnam it is 7 miles offshore.

Anchorage.—There is anchorage off Iskapalli in depths of 7 or 8 fathoms, over sand and mud, about 1 mile from the beach, and north-eastward of a bungalow situated $\frac{3}{4}$ mile southward of the village. The holding ground is good, but a heavy surf runs on the beach.

Supplies.—A few sheep, fowls, and a small quantity of fish are obtainable; other necessities can be procured from Nellore, which is 23 miles distant by road.

Coast.—The coast from Iskapalli trends north-northwestward and is low and sandy to Ramiapatnam, a distance of 18 miles; there is a short scrub but no casuarina clump of any size on it between Iskapalli and $1\frac{1}{2}$ miles southward of Wuturpallipalem, at which place there is a high and large clump. Northward of Wuturpallipalem there are at first a few detached clumps, after which the trees are very even to Ramiapatnam.

Shoals.—A shoal with a least depth of $2\frac{3}{4}$ fathoms on it at low water lies 2 miles offshore abreast Tummalapenta; the bottom in the locality is uneven, with depths of 3 to 6 fathoms for about 1 mile around the shoalest part.

A shoal, about 500 yards in extent, with 4 fathoms on it at low water, lies about $2\frac{3}{4}$ miles northeastward of Tummalapenta and 2 miles offshore; uneven bottom, with depths of 5 to 6 fathoms, extends about $5\frac{1}{2}$ miles northward of this shoal.

On this part of the coast the water should not be shoaled to less than 10 fathoms until northward of Ramiapatnam.

Ramiapatnam.—At Ramiapatnam Village are some high casuarina clumps and a church, the red spire of which is visible over the trees. Tettu Temple, white, and 135 feet above high water, but not very conspicuous, is situated about 2 miles inland of the village.

Northward of Ramiapatnam the coast curves around to the north-northeastward for a distance of $10\frac{1}{2}$ miles to Manneru River mouth; it is low and sandy with several detached casuarina clumps.

Singarayakonda Temple, on a hill 168 feet high, 11 miles northward of Ramiapatnam and about $3\frac{1}{2}$ miles inland, is red in color, conspicuous from seaward, and the only landmark between Ramiapatnam and Kottapatam. A road leads from the coast about 1 mile northward of Manneru River, past the temple to Kandukur Town, $10\frac{1}{2}$ miles inland. There is some rising ground near the temple, which is, in places, visible through the casuarinas which fringe the coast.

Coast.—The coast from the entrance to Manneru River trends in a northerly direction, with a bend to the eastward, for 6 miles to Palar River, and then turns north-northeastward for 8 miles to Kottapatam; it is low and sandy.

Guntur District extends from the mouth of the Palar River to False Point Divi, the western bank of the Kistna River, forming its eastern boundary, a distance of about 66 miles; its principal ports are Kottapatam and Nizampatam.

Kottapatam, at which an extensive export trade used to be carried on, lies about 1 mile from the coast and is connected by a good road with Ongole, about 8 miles northwestward, where there is a railway station. Most of the trade with Kottapatam is now carried on through the Buckingham Canal, and the godowns on the beach are falling into disrepair.

Obelisk.—An obelisk, of a gray color, 38 feet high, and standing on a sand hill 12 feet high, is situated close to the customhouse on the beach at Kottapatam and is visible from all directions seaward.

Landmarks.—Kandalur Hill and Konijedu Hill, the latter 485 feet high, are connected by a ridge, and lie 11 miles westward of Kottapatam.

Chimakurti, a mountain 2,093 feet high, 22 miles northwestward of Kottapatam, is conspicuous in clear weather.

Anchorage.—There is anchorage during fine weather in a depth of 5 fathoms, about $2\frac{1}{2}$ miles from the shore, with the obelisk at Kottapatam bearing 295° .

In approaching Kottapatam do not shoal the water to less than 10 fathoms until the position is known, for fixing which the landmarks above given or Singarayakonda Temple are useful.

Town.—The town is well built, the streets and houses being constructed with unusual symmetry; in 1901 it had a population of 7,626, mostly Komatis, and it is noted for its extensive cultivation of ragi and for its casuarina groves.

Communication.—Ongole, a station on the East Coast Railway, is connected to Kottapatam by a good road.

Trade.—It exports vegetables and firewood to Ongole.

Shoal.—A shoal about $2\frac{1}{4}$ miles in length in a north-northeast and opposite direction, and $1\frac{1}{4}$ miles in breadth, on which there is a least depth of $1\frac{1}{2}$ fathoms, lies 4 miles northeastward of Kottapatam Obelisk. In the channel between this shoal and the land there are depths of from $2\frac{1}{4}$ to 4 fathoms. From the southern part of the shoal, patches, with depths of 3 to 5 fathoms over them, extend for a distance of 8 miles east-northeastward of Kottapatam Obelisk.

Mutapolli Bank, about 4 miles in length in a northeast and southwest direction, consists of three patches of hard sand, generally marked by overfalls, with least depths of $3\frac{1}{2}$ fathoms, 4 fathoms, and $4\frac{1}{2}$ fathoms, respectively; the least depth, of $3\frac{1}{2}$ fathoms, lies $9\frac{1}{4}$ miles eastward of Kottapatam Obelisk.

From the outer part of Mutapolli Bank the low coast is scarcely visible even in clear weather, and Konijedu and Kandalur Hills, which bear nearly west, are seldom seen, being 23 miles distant.

A shoal of 5 fathoms, $\frac{1}{4}$ mile in extent, with depths of $5\frac{1}{2}$ fathoms for $1\frac{1}{2}$ miles northeastward and southwestward of it, lies $7\frac{1}{2}$ miles northeastward of the shoalest spot on Mutapolli Bank.

Directions.—Approaching Mutapolli Bank, the water should not be shoaled to less than 14 or 15 fathoms by day or 30 fathoms by night, and the lead should be going, as the soundings decrease rapidly from a depth of 30 fathoms.

Nizampatam Bay, formed between Kottapatam and False Point Divi, a distance of about 40 miles in an east-northeast direction, has depths under 10 fathoms, and is free from shoals except those already mentioned near Mutapolli Bank; the shore is safe to approach to depths of 5 fathoms.

Gundlakamma River mouth, 6 miles northward of Kottapatam, only admits boats in fine weather; the river comes down in freshets in September, October, and November, and during high tides it is navigable for about 2 miles inland from its mouth.

The shore of the bay, in the vicinity of the river mouth and for 4 miles northward, is low and sandy with but few trees; casuarinas then commence and continue to line the tops of the sandhills near the sea for 20 miles toward the head of the bay; the trees are 30 to 40 feet high, and in places extend more than 1 mile inland. There are three villages along this shore, one of which is a post town.

A boat passage to a backwater and the Buckingham Canal lies $8\frac{1}{2}$ miles northward of Gundlakamma River mouth. The entrance has a southwest direction across a bar, which has a depth of about 6 feet on it at low water, but is only available even for a boat in fine weather.

From the end of the casuarinas to Nizampatam, a distance of 14 miles, the shore is backed by sandhills 6 to 8 feet high, rising to heights of 20 to 30 feet toward Nizampatam.

Beacons.—A beacon is situated about $\frac{1}{2}$ mile inland at the southern part of the outlets of the Gundlakamma River.

Beacons are also charted on the shore, about $9\frac{1}{2}$ miles north-northeast, and 20 miles northeast of the beacon near Gundlakamma River entrance, at the head of the bay southward of Nizampatam, and another $6\frac{1}{2}$ miles eastward of it.

Nizampatam, the principal town on the shores of the bay, is approached by creeks, in which there is always water enough for boats and at high water enough for small vessels.

Entrance.—The deepest entrance to the creek leading to Nizampatam is opposite a large white sandhill eastward of Dindi House, but there is another channel opposite Dindi House which can be used by ships' boats at any time but low water springs. Westward of and inside the entrance is a conspicuous clump about 60 feet high.

Dindi House is a large house on the beach at the entrance to the creek leading to Nizampatam; close to the house is a big tree, the top of which is 67 feet high.

Anchorage.—There is open anchorage in a depth of 5 fathoms, over mud, with Dindi House and tree bearing 21° , distant about 6 miles.

Tides and tidal streams.—It is high water, full and change, at Nizampatam entrance at 9h. 0m.; springs rise $4\frac{1}{2}$ feet, and neaps $3\frac{1}{2}$ feet. The tidal streams are weak and only felt inshore and at springs.

Town.—Nizampatam was the first place on the east coast where the British commenced to trade, and a factory was established in 1621; its population in 1901 was 4,216.

Supplies.—Fowls and eggs in limited quantities can be obtained, also sheep and fish in abundance, but no vegetables.

Trade.—Rice is exported to Negapatam and southern ports, timber is occasionally imported from Rangoon, and salt is sent up country by canal.

Coast.—The coast from Dindi House trends eastward for a distance of 5 miles to the entrance of a creek, navigable by boats, then southeastward and southward to False Point Divi.

Backwater.—North of False Point Divi is a considerable backwater formed by a long spit, which, commencing $2\frac{1}{2}$ miles north of False Point Divi, extends 4 miles northward, inclosing a sheet of water $\frac{1}{2}$ mile broad, and leaving an entrance at the north end. This backwater is connected by creeks with Kistna River.

False Point Divi, distant $12\frac{1}{2}$ miles southeastward from Nizampatam River entrance, is low and covered with small mangrove jungle.

Shoal ground, which dries in patches, extends 1 mile southward and 3 miles westward of the point.

Caution.—The 5-fathom contour line lies $4\frac{1}{2}$ miles and the 10-fathoms line $5\frac{1}{2}$ miles from the land; the top of the trees are just visible from the 10-fathom line. As the soundings decrease rapidly from the 100-fathom contour line, the lead must be kept going, and the land not approached nearer than a depth of 20 fathoms.

Currents.—There is scarcely any current in Nizampatam Bay. The current off False Point Divi sets to leeward, according to the monsoon, and parallel to the shore, being strongest near the 100-fathom contour line.

Kistna District is eastward of that of Guntur and has a coast line of about 55 miles; the principal port is Masulipatam.

Kistna River rises about 40 miles from the Western Ghats at Mahabaleshwar in the Bombay Presidency, flows eastward across the peninsula of India, and after a course of about 800 miles, falls into the Bay of Bengal by several branches, the mouth of one being near False Point Divi; the western bank is in Guntur, and the eastern in Kistna District.

The enormous amount of silt carried by the river has deposited and formed a wide alluvial delta, which extends seaward; at Bez-wada, at the head of this delta, a large masonry dam crosses the river and turns it into a network of irrigation channels spreading throughout the delta, and immediately below the dam the river is crossed by the East Coast line of the Madras Railway on a 12-span girder bridge.

The coast trends east-northeastward for 11 miles from False Point Divi, and then turns northward, forming a bay as far as Divi Point. It is low and monotonous, with a sandy foreshore and occasional low sandhills, backed by a fringe of jungle 30 to 40 feet high.

Kistna—Light.—A masonry tower, 144 feet in height and painted white, is situated on the southeast point of the delta, from which is exhibited, at an elevation of 140 feet above high water, a group flashing white light, visible 18 miles. (For details see Light List.)

Divi Point, about 1 mile eastward of the eastern mouth of Kistna River, is low and sandy, with a little scrub. Depths of less than 3 fathoms extend nearly 2 miles from the point, and there are only 5 fathoms 4 miles off.

Landmark.—An old lighthouse, a white masonry tower 50 feet high, situated on the left bank of the river near Divi Point, is maintained as a landmark.

Current.—In March the current off Divi Point has been found setting eastward at a rate of $1\frac{1}{2}$ miles an hour.

Directions.—Vessels bound eastward from Nizampatam should be guided entirely by the lead, and not approach the coast nearer than a

depth of 6 fathoms by day. Between False Point Divi and Divi Point the water should not be shoaled to less than 8 fathoms. By night, approach the coast with great caution, as the bank of soundings extend but a few miles seaward. Even by days the lead must be used, as the coast is very low and frequently obscured by haze.

Masulipatam, on a branch of Kistna River, is the chief port of Kistna District, but of small commercial importance, the greater part of the trade finding its way to Cocanada. In 1864 a tidal wave destroyed a great part of the town, and 30,000 persons perished.

The fort is now only the name of the locality near the flagstaff, which is 112 feet high; the port office is about 300 yards from the flagstaff. The entrance to the canal is near the fort.

Light.—A masonry tower, 43 feet in height and painted white, is situated on the coast immediately northward of Masulipatam River entrance, from which is exhibited, at an elevation of 33 feet above high water, a group occulting white light, visible 11 miles. (For details see Light List.)

Buoy.—A conical buoy, painted black, is moored in a depth of $3\frac{1}{2}$ fathoms $5\frac{1}{2}$ miles eastward of the flagstaff; it marks the position for boats to wait outside the bar in order to communicate with vessels approaching the port.

Anchorage.—The anchorage, in a depth of $4\frac{1}{2}$ fathoms, is about 1 mile southeastward of the black buoy, with the flagstaff bearing 274° , distant nearly $6\frac{1}{2}$ miles. The roadstead is capacious, and has good holding ground; but during the northeast monsoon, with a ground swell, communication with the shore is tedious and uncertain. The limits of the port are marked by boundary pillars. Ballast may not be thrown overboard in less than 10 fathoms of water.

Directions.—Bound to Masulipatam from the southward, make False Point Divi and stand northeastward, keeping in not less than 8 fathoms. On passing Divi Point the fort flagstaff will be visible, and soon afterwards the clumps of trees northward of Masulipatam River mouth. When the flagstaff bears about 292° , steer for the anchorage, keeping the lead going.

In June, July, and August sailing vessels should make Divi Point by daylight and hug the coast as close as prudence will permit, as westerly winds are frequently very strong during the southwest monsoon, when it is necessary to beat into the anchorage, which is tedious owing to the freshets setting off the land.

During the northeast monsoon vessels should invariably make Narasapur Point and then steer for the anchorage.

The river mouth, near which Masulipatam is situated, has a bar on which the depth is about 1 foot during the dry season. During October, November, and December boats are occasionally, but not often, unable, owing to the weather, to cross the bar and com-

municate with shipping. Cargo boats proceed up the river for a distance of about 4 miles to discharge at the wharf in the port or go on by canal to Bezwada, on the main channel of the Kistna River.

Storm signals are shown at Masulipatam.

Signals.—When communication with the shore is dangerous, owing to surf on the bar, a red and white checkered flag is hoisted at the flagstaff of the fort. When the surf becomes impassable a white pendant with a red ball is hoisted under that flag.

At night, three lights hoisted horizontally by a vessel indicate that a boat is urgently required; blue lights burnt and guns fired indicate fire or danger.

Tides.—It is high water, full and change, at Masulipatam at 9h. 15m.; springs rise about 5½ feet, neaps about 3¼ feet.

Town.—The town consists of three parts—the fort, the native quarter, and the European quarter—and of these the fort is almost nonexistent. Around the fort is a vast expanse of waste land, which is swamp in the rainy season, but firmer in summer, and across it a causeway about 2 miles in length leads to the native town.

Northward of the native quarter and along a sandy ridge are the houses of European residents; in 1901 the population was 39,507, but, unless affected by a new railway to be constructed from Bezwada, it is not likely ever to have much commercial importance. A tidal wave, in which about 30,000 people perished, caused great destruction to the town in 1864.

Communication.—There is weekly communication by steam vessels of the British India Co. with Madras and Rangoon and fortnightly with Calcutta and Bombay.

The nearest railway station is at Bezwada, which is 48 miles by road and canal from Masulipatam and connected with the Indian railway system; the canal is closed annually from March to May, inclusive. Masulipatam has telegraphic communication.

Hospital.—There is a civil hospital and dispensary.

Supplies.—Fresh meat and bread may be procured in small quantities, but vegetables are very scarce; the drinking water, shipped in casks, is not good.

Trade—Shipping.—The exports are paddy, hides, and grain, and the imports piece goods, twist, metals in manufactured state, and cement.

Climate.—The climate of Masulipatam is hot and dry, nearly all the rain falling in the southwest monsoon between June and October.

Coast.—From Masulipatam the coast curves in a northeastward and eastward direction for about 32 miles to Narsapur Point, and is low, sandy, and thickly wooded for 8 or 9 miles from Masulipatam, after which the trees are more scattered for about 10 miles, when they become thicker to Narsapur Point. About ¼ mile northward of

Masulipatam River mouth are two clumps of casuarina trees, long and wedge-shaped, the northern ends being the highest.

About $3\frac{1}{2}$ miles farther northward is a small pointed clump, and rather more than 1 mile northward of that, and close to the coast, is North Clump, which is large, very compact, about 60 feet high, and often appears like an island, the trees northward and southward of it being of a lighter color.

Obelisk and beacon.—An obelisk, about 60 feet above high water, stands on a sandhill about 1 mile northwestward of the southern casuarina clump.

A beacon about 20 feet high is situated on the coast about 11 miles northeastward of Masulipatam. Neither are conspicuous.

Wupputer River flows into the sea 25 miles east-northeastward of Masulipatam.

Depths offshore.—The coast between Masulipatam and Narsapur Point may be approached with care to 7 fathoms, which depth is generally about 5 miles off it.

Narsapur Point, the eastern entrance point of Vasishta Godavari River, is low, woody, and situated 37 miles northeastward of Divi Point.

Narsapur Point should not be approached to less than 7 fathoms by day, nor 20 fathoms by night; the 20-fathoms contour line is about 8 miles from it.

Obelisk.—An obelisk 80 feet in height stands nearly 1 mile northward of the point

Depths.—Vasishta Godavari River, which is the northern mouth of the Godavari, has about 7 feet at low water on its bar, which extends nearly 2 miles southward of the point, with 2 to 3 fathoms inside. The channel leading into the river is between two sand banks, on which the sea breaks. It divides the districts of Kistna and Godavari.

Town.—Narsapur Town, situated 8 miles up the river, has a celebrated Hindu shrine, visited once a year during a five days' festival by some 20,000 pilgrims; its trade has almost ceased. Boat building was once carried on, and native craft still resort to it for repairs; the population is about 7,000.

Communication.—There is a post and telegraph office at Narsapur.

Provisions may be procured at moderate cost.

Current.—In the bay westward of Narsapur Point the current is weak and variable.

Godavari District commences at Wupputer River, about 9 miles westward of Vasishta Godavari River mouth, and has about 70 miles of coast line; it has four British ports or roadsteads—Bandarmalanka, Coringa, Cocanada, and Upada. Besides these, Yanam or

Yanaon, a small French settlement, stands $5\frac{1}{2}$ miles southward of Coringa at the point where Coringa River issues from the Godavari.

Coast.—From Narsapur Point the coast trends for 15 miles in an east-northeast direction to the mouth of Vanteyam Godavari River, and is low but thickly wooded. The entrance of the Vanteyam Godavari is named Warreo, and off it a shoal spit forms during freshets. Two large and conspicuous clumps of casuarina trees are situated on the eastern bank near the mouth of the river. This coast may be approached to a depth of 10 fathoms; the 100-fathom contour line is about 9 to 14 miles offshore.

Beacon.—A pole beacon 26 feet high marks the entrance to the river.

Current.—In January and February the current at about 9 miles off the coast, between Narsapur Point and the Vanteyam Godavari, runs westward at a greatest rate of 2 knots.

From the entrance of the Vanteyam Godavari River the coast trends in an east-northeast direction for 23 miles to the mouth of Vrudha Gautami River, which is the southern entrance to the Gautami Godavari, the principal entrance.

The strong current has cut a channel 5 to 10 fathoms in depth through the alluvial soil, and the river is joined near its mouth by two feeders, which together make an outgoing stream running at the rate of 4 knots in the wet season. As the stream issues it is met by the swell always running on this coast, and two shoals have formed off the mouth of the river, the southern being Sacramento Shoal.

Beacon.—About $1\frac{1}{2}$ miles southwestward of the river entrance and $\frac{1}{2}$ mile inland, is Kotapalem Beacon, a pole 40 feet above high water.

Light.—From a masonry tower, 148 feet in height, near Kotapalem Beacon, a flashing white light is exhibited, at an elevation of 140 feet above high water, visible 18 miles. (For details see Light List.)

Sacramento Shoal, consisting of hard sand, is the extreme detached portion of the southern of the two shoals above mentioned; its outer edge is 2 miles from the line of coast. There are depths of 6 fathoms close outside it, and the 10-fathom contour line is about $1\frac{1}{4}$ miles to the eastward. The shoal nearly dries, and the sea always breaks on it, except at its outer edge.

Shoal water extends nearly $1\frac{1}{2}$ miles from the shore southward, 3 miles eastward, and $2\frac{1}{2}$ miles northeastward, from the lighthouse. Thirthalmundi Village, with huts on the coast, is situated about $5\frac{1}{2}$ miles northward of Sacramento Shoal.

Beacon.—A beacon, 32 feet in height and painted white, is situated at Thirthalmundi Village.

Clearink mark.—Thirthalmundi Beacon, bearing 349° , leads 1 mile eastward of Sacramento Shoal.

Anchorage.—Northward of the shoals there is anchorage in a depth of 4 fathoms, over mud, nearly 1 mile offshore, with shelter from winds between south-southeast, through west, and north-north-west. In rounding the shoals, give them a berth of 1 mile.

Vrudha Gautami River—Depth.—The least water in the channel over the bar is 9 feet at low water springs.

Directions.—Small craft can enter in fine weather, but sailing vessels require a fair wind. Steer about 231° in mid-channel over the bar, between the two lines of breakers, and when within Sacramento Shoal keep northwestward toward the single tree, which, in 1891, stood near the river mouth, following the line of the northern shoal at a distance of 400 yards until in the river. Inside the bar the water deepens to 4 to 6 fathoms.

Tides.—It is high water, full and change, at Sacramento Shoal at 9h. 15m.; springs rise $5\frac{1}{4}$ feet; neaps rise $3\frac{1}{4}$ feet. At neaps the tide is about half an hour earlier than at Cocanada.

Current.—During the months of January to April, inclusive, a current runs steadily to the northeastward at a short distance from the shore, in the vicinity of Sacramento Shoal; its velocity is greatest, sometimes 4 knots, at a distance of 5 miles from the shore.

Between Cocanada and Bimlipatam its distance from the shore is greater, and its velocity less; inshore of the current slack water is generally found, but sometimes close inshore the tidal stream will be experienced.

Coast.—Between Vrudha Gautami River mouth and Godavari Point, about 20 miles to the northward, the coast is very low. In this vicinity distances judged by eye are likely to be erroneous, owing to the sand haze. Bahiraswami Temple is $4\frac{1}{2}$ miles northward of Kotapalem; and 2 miles farther northward is Thirthalmundi Village, situated on a mound, with the obelisk already mentioned on the beach. There are several sand hills between the mouth of Vrudha Gautami and Thirthalmundi, but none northward of that village. A small break in the coast occurs $2\frac{1}{2}$ miles northward of Thirthalmundi.

Hope Island is low, swampy, covered with jungle, and, being only 3 feet above high water, is submerged during high tides. It is one of a broken chain of similar islands, and part of the delta of Godavari River.

Godavari Point, the southern point of Cocanada Bay, is the northern end of a series of narrow banks extending northward from Thirthalmundi, and forming the coast; they are low, sandy, and covered in places with small scrub, and the sea breaks heavily on them during the southwest monsoon. The point has extended to the northwestward to a point 5.6 miles 77° from Cocanada Old Lighthouse and dries soon after half-ebb; and the entrance to

Godavari River is westward of it; both the point and the entrance are also known as Gordeware.

Buoy.—A black pillar buoy is moored in 8 fathoms water north-eastward of Godavari Point and 1.7 miles 90° from its northwestern extremity. The position of this buoy can not always be depended upon.

Depths offshore.—Between Sacramento Shoal and Godavari Point the soundings are regular; the 10-fathom contour line being $1\frac{1}{2}$ miles from the outer edge of Sacramento Shoal, $2\frac{1}{2}$ miles from the coast off Thirthalmundi, and 2 miles outside Godavari Point.

CHAPTER III.

ORISSA COAST—COCANADA TO FALSE POINT AND DHAMRA RIVER.

Cocanada, situated on the shore of Coringa Bay, about 7 miles westward of Godavari Point, stands on the banks of a small river, which is connected with Samalkot and Rajahmundry Canals, the latter, 32 miles in length, joining the Godavari River at a town named Dowlaishweram and is the principal seaport of Godavari District, as well as the safest natural port on the eastern coast of India.

Two piers or groines extend from the mouth of Cocanada River, and a channel of sufficient depth to enable cargo boats to communicate with shipping at all times of tide is preserved by dredging. The limits of the port are defined on shore by boundary pillars and extend seaward to 13 fathoms water; no ballast is permitted to be thrown overboard in a less depth than 12 fathoms.

On the north bank of the river and about $\frac{1}{4}$ mile from the sea is an old lighthouse tower, 80 feet high, painted black; nearly $\frac{1}{2}$ mile westward of the tower is the port office.

Extensive quays extend the entire length of the tidal creek, opposite the merchants' offices, and there are greatly improved facilities for working cargo.

Cocanada Bay is shallow, with extensive mud flats, which dry at low water extending off the mouths of Godavari River. The bay has been silting up for many years, the shoals, formed by the deposit brought down by Godavari River, having advanced, and in 1903 the bay was found to have shoaled from 2 to 3 feet. The shores of the bay are low and liable to periodical inundations during cyclonic storms.

The 5-fathom contour line in the entrance to the bay has extended seaward, and is situated on a line joining the north extremity of Godavari Point to a point situated at a distance of $1\frac{1}{2}$ miles, eastward, from Vakalapudi Lighthouse.

Light.—At Vakalapudi, $\frac{1}{4}$ mile inland on the west side of Cocanada Bay and nearly 5 miles northward of Cocanada River Entrance, is a column, 76 feet in height painted white, from which is exhibited at an elevation of 80 feet above high water a group flashing white light, visible 14 miles. (For details see Light List.)

Signal station.—Vakalapudi Lighthouse is in telephonic communication with Cocanada port office, and is a signal station.

Storm and weather signals are shown from Vakalapudi Lighthouse.

Harbor lights.—On the pier ends at Cocanada River Entrance fixed red lights are exhibited 10 feet above high water, which should be seen from a distance of about 2 miles in clear weather. These lights are shown as guides to boats entering or leaving the river.

Buoys.—A large pillar buoy, painted black, is moored in 8 fathoms water about $1\frac{1}{2}$ miles eastward of the extremity of Godavari Point.

Anchorage.—The anchorage, in from 4 to 5 fathoms off Cocanada, with Vakalapudi Lighthouse bearing 320° and the old lighthouse about 239° is safe, with a soft bottom and good holding ground. Vessels lie here at all seasons, and, although about 4 miles from Cocanada River Entrance, yet, owing to the sea in the bay being generally smooth, communication with the shipping and the shore is rarely impeded.

There is also anchorage in about $4\frac{1}{2}$ fathoms, with Vakalapudi Lighthouse bearing 318° , distant about 1.4 miles, but less water may be obtained in these positions, as the bay is gradually silting up. Although open to winds from north-northeast to east-southeast, vessels do not put to sea from here on the approach of bad weather, and should a vessel be driven from her anchors the soft muddy bottom prevents serious damage.

Godavari River rises about 70 miles northeastward of Bombay, traverses the peninsula in an easterly direction, and is about 900 miles in length, with a breadth in places during the rainy season of $1\frac{1}{2}$ miles; its northern and principal mouth is about 7 miles eastward of Cocanada.

The main channel into Godavari River, westward of Godavari Point, has a depth of about 1 foot at low water on the bar, and deepens inside. Lanes are cut through the jungle from the western side of the channel near Hope Island toward the town of Coringa. The entrance to Coringa River, which is very shallow, is about $3\frac{1}{2}$ miles southward of Cocanada River Entrance, and a road connects Coringa and Cocanada Towns.

Coringa is a closed port, the channel through the flats leading to the river having only from 1 foot to 2 feet at low water. About $5\frac{1}{2}$ miles southward of Coringa is the French settlement of Yanam or Yanaon.

Tugs.—Two tugs are available.

Directions.—A sailing vessel from the southward bound to Cocanada in the southwest monsoon should make the land in about latitude $16^\circ 30'$ north, and thence run along the coast in a depth of not less than 10 fathoms. Care is necessary in passing Sacramento

Shoal. The pillar buoy eastward of Godavari Point may be seen, but until Vakalapudi Lighthouse bears 292° the water should not be shoaled to less than 10 fathoms, when steer for the anchorage.

Working into the anchorage in the southwest monsoon, do not stand farther southwestward in the bay than depth of 6 fathoms at low water; the lead must be constantly used, as the water shoals rapidly, and the depths may be less than charted.

During the northeast monsoon, make the land at about Pentakota, 30 miles northeastward of Cocanada, and then steer along the coast in a depth of 12 fathoms. When Vakalapudi Lighthouse bears about 247° steer for the anchorage. Northward of Cocanada the land appears bold, with high land extending away northeastward; southward of Cocanada the coast is low and sandy, interspersed with a few sandy hillocks, palmyra trees, or low jungle.

At night, from the southward care is necessary; the lead should be kept going, and the water should not be shoaled to a less depth than 12 fathoms. When Vakalapudi Light bears 292° steer for it on that bearing and anchor in 7 to 8 fathoms.

From the northward, during the northeast monsoon, approach with Vakalapudi Light bearing 247° ; when in 10 fathoms water and the light distant 9 miles, steer about 232° , and on the depth decreasing to 7 or 8 fathoms anchor with the Vakalapudi Light bearing 292° , distant about 3 miles.

Tides.—It is high water, full and change, at Cocanada at 8h. 50m.; springs rise $5\frac{1}{4}$ feet, neaps $3\frac{1}{4}$ feet; neaps range $1\frac{1}{4}$ feet. The tides are irregular, and greatly influenced by the wind and the freshets out of Godavari River.

The tides are subject to diurnal inequality, which may accelerate or retard the times of high and low water, and increase or diminish the rise by, at times, as much as 1 foot.

Tidal streams.—The tidal stream sets northeastward during the falling tide, southwestward during the rising tide. The tidal streams at springs are strong, especially from October to February, and must be taken into account when closing the land.

At the anchorage there is very little tidal stream; it is usually slack during the rising tide and sets northeastward during the falling.

Town.—Cocanada Town, situated on a sandy plain a little above sea level at the head of Cocanada Bay, is the headquarters of the district administration and the chief port on the Coromandel Coast northward of Madras, but, owing to the bay silting, its trade has declined; in 1913 the population was 40,500. There is a large European community, and most foreign governments are represented by consular agencies. It has a salt factory, a large rice-husking mill, several oil factories, an iron foundry, and cheroot manufactory.

Communication.—The British India Co.'s steamers from Rangoon call weekly, and those running between Bombay and Calcutta fortnightly; the Asiatic Steam Navigation Co. and Clan Line have a regular service of steamers. A branch railway runs from Cocanada Port to Samalkot, 391 miles from Madras, where it connects with the East Coast Railway, and there is telegraphic communication.

Coal and supplies.—A very small quantity of coal is kept in stock as the amount annually imported is only 500 tons, but a large supply may be obtained on short notice; two wharves, each 25 feet in length, have a depth of 4 feet alongside. Eighteen lighters, of an aggregate capacity of 430 tons, are available and 250 tons of coal could be put on board in 24 hours.

Fresh provisions are plentiful and fairly cheap, and water can be supplied alongside in iron tanks. Marine stores or salt provisions can be obtained. Water is obtained from the Samalkot Canal, the waterworks, completed in 1903, giving a supply of 10 gallons per head to a population of 40,000.

Repairs.—Small repairs can be executed by the public works department at Dowlaishweram, 32 miles by canal from Cocanada.

There is a steam crane capable of lifting 12 tons, and also a pair of shears to lift 7 tons, on Cocanada Wharf.

Hospital, etc.—There is a seamen's hospital at Cocanada. Beriberi disease is endemic, but is mostly confined to natives.

Trade.—The principal exports are cotton, oilseeds, rice, tobacco, pulses, and gingelly oils, piece goods, twist, yarn, gunny bags, rice, and kerosene oil. The imports are sugar, oils, metals, yarns, and textile fabrics.

Current.—From about August to November the current sets southwestward, and from about the middle of December until July it sets northeastward at a short distance from the land between Sacramento Shoal and Bimlipatam.

From January to April, both inclusive, it attains its greatest rate, sometimes as much as 4 knots an hour, in the vicinity of Sacramento Shoal and about 5 miles from the land; between Cocanada and Bimlipatam it extends further offshore with a less rate; inshore of the current there is generally slack water.

In July and August its rate is less than 1 knot. This current also prevails off the coast northeastward to False Point, but is not so strong as off Cocanada Bay.

Coast.—From Vakalapudi Lighthouse the coast, trending in a northeast direction, is low for about 10 miles, with numerous villages and coconut trees. Low sand hills then commence and continue to Pentakota, a further distance of 15 miles. About $5\frac{1}{2}$ miles northeastward from Vakalapudi Lighthouse is Upada, a small port for native craft.

Beacon.—At Wontimaudi, nearly 12 miles northeastward of Upada, there is a masonry beacon on a sandhill close to the coast, but it is not easily seen.

Depths offshore.—The 10-fathom contour line, which is about 5 miles eastward of Vakalapudi, gradually approaches the coast, and is nearly 3 miles southeastward of Pentakota.

Round Hill, a mountain, 2,143 feet high and 26 miles northward of Cocanada, shows well from near Cocanada in clear weather.

Vizagapatam District, commencing about 3 miles southwest of Pentakota, has a coast line of nearly 100 miles, and includes the ports of Vizagapatam and Bimlipatam.

Pentakota, 30 miles northeastward of Cocanada, is situated in the southern part of Vizagapatam District, and at the mouth of a river; it has a post office and customhouse, but is not now visited by shipping.

A heavy sea rolls in during the southwest monsoon, when the river is closed; during the northeast monsoon the river is open.

At the entrance to the river are two sand hills of moderate height, and a coconut grove close to them.

Aspect.—Sudikonda, 3 miles northward of Pentakota River entrance, is a cone-shaped hill 523 feet high; although not the highest hill in the vicinity, it is the most conspicuous, owing to its form and color; and shows well from seaward when bearing northward of 281° .

Tuni Hill (not named on chart), 8 miles from Pentakota River mouth, is conical in shape and a good landmark.

From Pentakota to Vizagapatam the coast trends northeastward and is a succession of rounded hills, rising from a low sandy plain. These hills show well at night.

Beacons.—Dongalkonda is a conspicuous white obelisk on smooth rising ground $\frac{1}{2}$ mile inland and 4 miles northeastward of Pentakota. Polarem, a small but very conspicuous rocky eminence, 72 feet high, on the beach 13 miles northeastward of Pentakota, is surmounted by a beacon 15 feet in height.

Sanjib Peak, remarkable and conical, with a somewhat flattened and broken summit, is 2,139 feet high, and situated 11 miles northwestward of Polarem.

The Orissa or Orixa Coast commences southward of Wattara, extending thence to Hugli River entrance, but the southern part of this coast is generally known as the Northern Cicars, and the name Orissa is applied to that northward of Ganjam.

Wattara, nearly 7 miles northeastward of Pentakota, is situated on a table-land at the south entrance point of a small bight formed at the mouth of three small rivers. The entrance is almost entirely blocked at low water.

Rambhil, a remarkable round hill, 606 feet high, situated 4 miles northeastward of Wattara, presents a steep face to seaward; it is surmounted by a beacon 16 feet in height.

Pudimadaka, about 8 miles northeastward of Wattara, is a small village on the shore of a bight about $\frac{1}{2}$ mile in extent. Pillar Rock, a rocky islet 30 feet high, situated south-southeastward of the village and about 3 cables offshore, and some dark cliffs on the coast near it, show conspicuously on the white sandy beach.

Pillar Rock has about 5 fathoms near it to seaward, and a ledge of rocks which serves as a breakwater during the southwest monsoon lies between it and the coast, so vessels then can load with facility. A small export trade is carried on from Pudimadaka.

Depths offshore.—The 10-fathom contour line is only $\frac{3}{4}$ mile outside Pillar Rock.

Anchorage.—There is anchorage during the southwest monsoon in 5 fathoms with Pillar Rock bearing about 214° , and the godowns on the beach 281° ; but, during the northeast monsoon, the anchorage for a sailing vessel is farther from the shore, in 7 or 8 fathoms, so as to give Pillar Rock a wide berth in case of being compelled to get under weigh.

Coast.—From Pudimadaka the coast trends in a northeast direction, curving outward slightly, for about 21 miles to Vizagapatam; it is broken and rocky, but no rocks extend more than 600 yards from it, and the 20-fathom contour line is from 4 miles to $1\frac{1}{4}$ miles from the beach.

The coast is backed by a plain studded with hills, and the sand has drifted so high on the southwestern sides of some of them near the coast that they are conspicuous.

A rock, about 4 miles northeastward of Pillar Rock, appears from the northward as a low black double rock on the sandy beach. The coast immediately north and south of it is sandy, with a few scattered rocks along the beach.

Kutkonda, $10\frac{1}{2}$ miles northeastward of Pillar Rock, is a small, conspicuous rocky promontory 145 feet high.

Beacon.—A beacon, 15 feet in height, stands on Kutkonda.

Pigeon Islet, $\frac{1}{2}$ mile offshore in a small bay, 5 miles northeastward of Kutkonda, is small, rocky, and 82 feet high.

Yarada Mountain, 3 miles northward of Pigeon Island, is 1,174 feet high, slopes gradually toward the coast, and terminates abruptly eastward in Dolphin's Nose, a bluff headland, 536 feet in height, with a masonry tower and flagstaff on its summit, and several houses on its north side.

Vizagapatam is a seaport with many natural advantages and with an increasing trade: the river which separates the town from

Dolphin's Nose is barred at its entrance and only capable of admitting boats and small steam launches.

A scheme for dredging the backwater and river and forming an inner harbor and docks is proposed, which would probably render it the finest harbor on the coast, enabling seagoing vessels to go alongside the docks.

The limits of the port are defined by boundary pillars.

Light.—A fixed white light is exhibited, at an elevation of 73 feet above high water, from a masonry tower, 59 feet in height, situated near the fort flagstaff, visible 14 miles.

Storm signals are shown at Vizagapatam.

Anchorage.—The best position is in about 5 fathoms water, over sand, with Vizagapatam Fort flagstaff bearing 288° , and the flagstaff on Dolphin's Nose 224° . Care must be taken in anchoring, as the soundings shoal quickly, and the stern of a large vessel anchoring in 6 fathoms might swing into $4\frac{1}{2}$ fathoms at low water. The bottom inside the 3-fathom line northward of the town is foul.

Directions.—Dolphin's Nose, though a remarkable headland when approached from along the coast northeastward or southwestward, is not readily made out from the high land beyond it, when viewed from a distance seaward. In making Vizagapatam during the northeast monsoon, endeavor to sight Rusi or Sugarloaf Hill; from the southward, make Pigeon Islet.

Maonderu River drains the high land on which Vizagapatam is situated and discharges into the small bight immediately north of Dolphin's Nose. The bar, which has a depth of 5 feet over it at low water spring tides, is dangerous, and can only be crossed in ships' boats in fine weather and during southerly winds. Mud docks for native craft are situated about 1 mile up the river.

Tides.—It is high water, full and change, at Vizagapatam at 8h. 26m.; springs rise $5\frac{1}{4}$ feet, and neaps $3\frac{1}{2}$ feet; neaps range 1 foot. The tides are subject to diurnal inequality, which may accelerate or retard the times of high and low water, and increase or diminish the rise, at times, 1 foot.

Town.—Vizagapatam, besides being the headquarters of the usual district staff, is the residence of the controlling officers in the several departments, and is a flourishing seaport. On the west of the town is a large backwater, from which a small stream runs to the sea, and on the north and south are two parallel ridges of low hills about 1,800 feet high and 4 miles apart. A British factory was established at Vizagapatam in 1687. In 1901 the population was 40,892.

Waltair, about $2\frac{1}{2}$ miles northeastward and a suburb of Vizagapatam, pleasantly situated on a ridge of low hills facing the sea, is

the head military quarters of the district, where most of the Europeans reside.

Communication.—There is a weekly communication with Madras, Rangoon, and coast ports, and fortnightly with Bombay and Calcutta, by steamers of the British India Co. The Asiatic Line have a fortnightly service to Calcutta and Bombay, via coast. There is a regular weekly service of Clan Line steamers to London and the Continent, taking manganese ore and jaggery. Occasionally vessels are chartered to take manganese ore to the United States.

A branch railway runs from Vizagapatam to Waltair, where it connects with the East Coast Railway. Vizagapatam has telegraphic communication.

Supplies.—Fresh meat, bread, and vegetables may be procured at reasonable rates; the water is good, and may be obtained from the port officer, but it runs very slowly.

Repairs.—The railway would undertake repairs to hull or machinery of vessels if required.

Landing.—There is a landing and shipping platform at Vizagapatam Wharf, with railway connections.

Hospital.—The civil hospital will accommodate 77 patients, and there is a dispensary where Lascars may be treated.

Trade.—The principal exports are manganese ore, raw sugar, hides, skins, myrabolams, and indigo; and imports, cotton twist, yarn, piece goods, iron, and timber.

Winds.—From March to June, southwest winds prevail; in July and August, northwest; in September, westerly; and from October to December, northeast. In the latter months, northeast winds are fresh during the day, with light westerly winds at night. Heavy squalls with rain occur in October and November.

Waltair Point, about 4 miles northeastward of Vizagapatam, is low and sandy with a rocky foreshore, and red sandhills which are at times conspicuous from the offing. On the point is a house in ruins, with a grove of palm trees behind it, and the north boundary of the port of Vizagapatam is close southward of this. The bottom within a depth of 8 fathoms is foul and vessels should not anchor near the point.

From Waltair Point the coast trends in a northeast direction for 12 miles to Bimlipatam, situated on the south entrance point of a small river. About $3\frac{3}{4}$ miles from Waltair Point and near the coast is Rusi or Sugarloaf, a conspicuous round-topped hill, 490 feet high.

Beacon.—A beacon stands on Rusi or Sugarloaf.

Upada Bluffs, 2 miles northeastward of Sugarloaf Hill, have the appearance of flat tablelands about 400 feet high, with a steep face to seaward. Shoal water extends nearly $\frac{1}{2}$ mile offshore in their vicinity.

The high land terminates about 4 miles northward of Sugarloaf Hill, whence to Bimlipatam there are isolated conical hills; a large sandhill, 314 feet high, and about 2 miles southwest of Bimlipatam Hill, is noticeable.

Bimlipatam is one of the chief ports on the east coast, but the maritime trade has been affected by the completion of the railway between Madras and Calcutta. A hill, 530 feet high, on the northeast slope of which stands the town, is surmounted by a few scraggy trees and a pyramidal obelisk 16 feet high.

On its eastern slope, about halfway up, is a temple, painted white, which shows well when the sun shines on it. This temple is always brightly illuminated every Saturday from sunset to midnight, and the lights may be seen from a long distance. A tall chimney of a gunny factory at Chitavalasa is also a conspicuous object.

Light.—From a masonry tower, 36 feet in height, situated near the post office, a group occulting white light is exhibited at an elevation of 35 feet above high water, visible 11 miles. (For details see Light List.)

Storm signals are shown at Bimlipatam.

Anchorage.—In the southwest monsoon anchorage may be obtained in from 6 to 7 fathoms water, with the lighthouse bearing 267° , and in the northeast monsoon anchor in the same depth, with the flagstaff from 261° to 250° in both positions nearly 1 mile off-shore.

The bottom, consisting of mud and sand, is good holding ground, and the anchorage is smoother than at adjacent ports.

Tides and tidal streams.—It is high water, full and change, at Bimlipatam at 8h. 53m.; springs rise $5\frac{1}{4}$ feet, neaps $3\frac{1}{4}$ feet, and neaps range $1\frac{1}{4}$ feet. In the roadstead the tidal stream is scarcely perceptible.

Town.—The town, built on the northeastern slope of the hill on which are the temple and obelisk, is of considerable importance. Northward of the town is a large, shallow backwater, the entrance to which, $\frac{1}{4}$ mile north of the town, is used by boats, but is almost dry at low water. The population of the town in 1901 was 10,212.

Communication.—British India Co. steamers between Cocanada and Rangoon call weekly, and those between Bombay and Calcutta fortnightly, as also do those of the Asiatic Co. Clan Line steamers also call occasionally, taking cargo to England. Bimlipatam has postal and telegraphic communication.

Communication with the shore through the surf in ships' boats is prohibited.

Supplies.—Fresh meat, live stock, and native vegetables in season are obtainable and very cheap; fresh water in casks may be procured.

Landing.—The landing place is on the beach between the entrance to the backwater and the port office.

Repairs.—Small repairs can be executed at the East Coast Railway workshop.

Hospital.—There is a hospital at Bimlipatam to which Europeans are admitted.

Trade.—The principal exports are gingelly and niger seeds, indigo, myrabolams, hides, horns, and gunny bags; the imports, raw jute, cotton twist, piece goods, machinery, and European stores and liquors. At Chitavalasa, about $2\frac{1}{2}$ miles north-northwestward of Bimlipatam, there is a large gunny-bag manufactory, with a conspicuous chimney. Large quantities of salt are also made. Vessels are loaded and discharged by means of surfboats.

Rainfall.—The average annual rainfall at Bimlipatam is 32.6 inches, of which 25.6 inches fall from June to October.

Coast.—The coast between Bimlipatam and Konada, 10 miles northeastward, is sandy and broken about midway by some red cliffs 20 to 40 feet high, conspicuous from seaward in the forenoon when the sun shines on them. Between these cliffs and Konada the beach is fronted by rocks extending a short distance seaward.

Amnam Hill, 833 feet high, smooth, flat-topped, and bare, situated about $3\frac{1}{4}$ miles north-northeast of Bimlipatam Lighthouse, is noticeable.

Beacon.—A beacon stands on Kaulvada, a hill, 246 feet high, about 2 miles northeastward of Amnam.

Konada is situated near the mouth of a small river, the southern side of which rises in bare sandhills to the rising ground extending to Amnam Hill; on the low ground on the northern side are several white buildings and some coconut trees. Konada, a town with a population of about 5,000, has a large salt factory and police and post offices; it has no trade.

Anchorage may be obtained off the river mouth in depths of 5 or 6 fathoms, over sandy bottom.

From Konada the coast trends in a northeasterly direction for 37 miles to Kalingapatam Lighthouse, and throughout it is a sandy beach, backed by sandhills from 40 to 60 feet high, broken only by Languliya River mouth, 25 miles from Konada. Between Konada and this river the hills in many places approach the coast; but between the river and Kalingapatam there is an extensive plain, dotted here and there with isolated hills.

Kandivalasa (Santapilli) Peak, about $7\frac{1}{4}$ miles northward of Konada, is 1,762 feet high, and the loftiest and most prominent peak in this locality, presenting a nearly conical appearance on all bearings from seaward.

Santapilli Light.—A concrete tower, 73 feet in height, is situated $\frac{1}{2}$ mile inland at Santapilli, from which is exhibited, at an elevation of 140 feet above high water, a group flashing white light visible 18 miles. (For details see Light List.)

Santapilli Rocks, a patch 800 yards in length in a north and south direction, less than 400 yards in width, and with a least depth of $1\frac{1}{4}$ fathoms over it, lies $6\frac{1}{4}$ miles southeastward of Santapilli Lighthouse and $5\frac{1}{4}$ miles off the land. It has general depths of 9 and 10 fathoms close around, but depths of $6\frac{1}{2}$ fathoms extend $\frac{1}{4}$ mile southward, and of 5 fathoms about 600 yards northward, of the patch. In fine weather the sea does not break on these rocks, nor is there any discolored appearance over them; but the sea breaks heavily with a moderate swell.

Caution.—Santapilli Rocks are in the track of coast navigation.

Clearing marks.—Santapilli Lighthouse, in line with Kandivalasa Peak, bearing 322° , leads $1\frac{1}{4}$ miles southwestward of the rocks; and the summit of an isolated, bare, red, double peaked hill, 384 feet high, and $1\frac{1}{2}$ miles north-northeastward of Santapilli Lighthouse, in line with Kandivalasa Peak, 304° , leads 2 miles northeastward of them. The channel inside Santapilli Rocks may be taken during daylight.

At night pass outside the rocks, and while Santapilli Light bears between 290° and 308° do not shoal the water to less than 20 fathoms.

Beacon.—A beacon, 15 feet high, stands on Ramachandrapur, a flat-topped hill, 538 feet high, situated 5 miles northeastward of Santapilli Lighthouse.

Agra Rock is a patch, with a depth of $3\frac{1}{4}$ fathoms on it at low water, lying $8\frac{1}{2}$ miles east-northeast of Santapilli Lighthouse, and 1 mile offshore; the sea is not discolored over this rock, and rarely breaks on it. Kandivalasa Peak opens southward of Ramachandrapur Beacon, bearing 279° , leads $\frac{3}{4}$ mile southward of Agra Rock.

Currents.—The currents in this vicinity depend principally on the prevailing wind, and run parallel to the coast. The greatest rate observed between Santapilli Rocks and the mainland was 1 mile.

Ganjam District, commencing at Languliya River, has a coast line of about 100 miles, and the ports of Kalingapatam, Gopalpur, and Ganjam.

Languliya River, forming the boundary between the districts of Vizagapatam and Ganjam, flows into the sea at 20 miles northeastward of Santapilli Lighthouse; it is a broad though shallow stream, filled with granite boulders, and navigable only by native vessels of light draft. Upon the left bank of the river, and $5\frac{1}{2}$ miles inland, is the town of Chicacole, once a military station, and the chief station in Ganjam District.

Kalingapatam, the southern port of Ganjam District, situated on the coast and on the southern side of Vamsadhara River entrance, about 13 miles northeastward of Languliya River mouth, is an open roadstead, protected from the south by a sandy point and some rocks which extend seaward about $\frac{1}{2}$ mile above water near the land but submerged farther out. The country in the vicinity is low and flat. The light obelisk is the southern boundary mark of the port, the northern being the line of the south end of Ampalam Village.

Light.—From a stone obelisk, 73 feet in height, painted white, situated on Sandy Point, $1\frac{1}{2}$ miles southward of Kalingapatam, an occulting white light is exhibited, at an elevation of 76 feet above high water, visible 14 miles. The obelisk has a dark blue capital and an outside spiral ladder, painted red. (For details see Light List.)

Sahliundam, $5\frac{1}{2}$ miles westward of Kalingapatam Light obelisk, is a conspicuous, bare, wedge-shaped hill, 409 feet high and trending eastward. On its eastern slope are two white temples and a tree.

About 4 miles northeastward of Sahliundam Hill, a low jagged rocky ridge of hills commences.

Satara Reef, with $3\frac{1}{2}$ fathoms water, over rock, is situated about 1,200 yards offshore, and 1,700 yards northeastward of Kalingapatam Light obelisk. The reef is steep-to on its northern and eastern sides, having a depth of 7 fathoms, over mud, within 100 yards, but there are two rocky 5-fathom patches southwestward of the reef, and between it and the shoal water, which extends about $\frac{1}{4}$ mile off the coast.

Anchorage in the southwest monsoon may be obtained in a depth of 5 fathoms with the port flagstaff bearing 309° , and the light obelisk 202° ; and in the northeast monsoon in 4 to 5 fathoms, with the port flagstaff bearing 295° and the light obelisk 202° .

Storm signals are shown at Kalingapatam.

Vamsadhara River is not used for navigation, as the entrance is encumbered with sand banks.

Tides.—It is high water, full and change, at Kalingapatam at 8h. 33m.; springs rise $4\frac{1}{2}$ feet; neaps rise 3 feet.

Town.—The town, one of the early seats of Mohammedan government in the Telugu country, shows signs of its ancient importance in the ruins of mosques and other buildings, and, after rain, small gold coins of great age are found on the site of the old city. In 1901 the population was 5,019.

Communication.—Steam vessels of the British India Co. between Cocanada and Rangoon call weekly, and those between Bombay and Calcutta fortnightly, at Kalingapatam, and there is telegraph communication with all parts.

Supplies.—Fresh provisions can be obtained, but only in small quantity; they may, however, be procured from Chicacole, 14 miles

distant, but two days' notice must be given. Fresh water here can not be recommended.

Trade.—The exports are chiefly grain, pulse, myrabolams, and turmeric; and imports, haberdashery, glassware, and gunny bags.

Coast.—Between Kalingapatam and Bavanapadu the coast is straight and sandy, backed for the first 10 miles by numerous isolated hills, which rise gradually in height as their distance from the coast increases. The country round Bavanapadu is low and flat.

Bavanapadu is 19 miles northeastward of Kalingapatam, and about 1 mile southward of the village a slight bend in the general direction of the coast forms a small point, off which rocks, 12 feet high, extend about 200 yards; a small river, the entrance to which is shallow and entirely closed at low water, runs into the sea about $\frac{1}{2}$ mile northward of the rocks.

Beacon.—On the beach at Bavanapadu there is a high circular beacon, painted black and white in horizontal bands.

Pundi.—About 8 miles northeastward of Bavanapadu is a rounded rocky point; Pundi is situated 1 mile farther northward, within the mouth of a small river. The town is not visible from the sea, but a high white obelisk, with its summit 60 feet above the sea, and a flagstaff, close together on the north side of the river, indicate its position; Bendi Hills, a flat range, 576 feet high, lie 3 miles northwestward of Pundi. Khirsinga, a small red hill, 169 feet high, is on the coast about $1\frac{1}{2}$ miles northeastward of the obelisk.

Anchorage.—The anchorage off Pundi is in 7 to 8 fathoms water, over sand, $\frac{3}{4}$ mile offshore, with the obelisk bearing about 280° . The river has about 3 feet water on the bar at low-water springs, and in very fine weather native vessels up to 70 tons enter and anchor off the village.

Tides.—It is high water, full and change, at Pundi River entrance at 9h. 5m.; springs rise $6\frac{1}{2}$ feet, neaps rise $4\frac{1}{2}$ feet, neaps range 2 feet.

Village.—The village of Pundi is small, and, having no trade, is of little importance. Ships' boats can enter the river with safety at high water, when the swell is moderate.

Communication.—There is a post office in the village; a good road connects Pundi with the trunk road near Bendi Hills, 3 miles inland.

Supplies can only be obtained in very small quantities, but fish is abundant and cheap.

Coast.—Between Pundi and Baruva, nearly 15 miles northeastward, the coast is sandy, and, except near Baruva, rises gradually and is fairly well wooded.

Rati Beacon, 8 miles northeastward of Pundi, is an obelisk, 14 feet high, situated $\frac{1}{2}$ mile inland on a double-peaked hill 342 feet

high, at the end of a small range of about the same height running down to the coast. This range is very prominent from the north-eastward or southwestward, and at a distance of 4 or 5 miles has the appearance of a headland.

Mahendragiri Range, precipitous, and about 5,000 feet in height, is about 14 miles northwestward of Baruva.

Rock.—A rocky patch with $6\frac{1}{2}$ fathoms on it and 9 to 10 fathoms around lies $2\frac{3}{4}$ miles east-northeastward of Rati Beacon, and nearly $1\frac{1}{4}$ miles offshore.

Baruva, a town of some importance, is situated on the left bank of a small river; the customhouse and a few native houses being the only parts visible from seaward, but a grove of casuarina trees to the southwestward of the former is conspicuous and the flagstaff and two high beacons mark its position. The surrounding country is level and the coast fringed with coconut trees.

Lights.—On the yardarms of the port flagstaff, at an elevation of 46 feet above high water, two fixed white occasional lights are exhibited from lanterns, and should be seen from a distance of 3 miles in clear weather.

Beacons.—Two beacons, 50 feet high, about 65 feet above high water, and 70 yards apart, in a 11° and opposite direction, are situated about 400 yards northeastward of the flagstaff; the southern beacon is painted white and the northern black and white in horizontal bands.

Anchorage.—The best anchorage is in $4\frac{1}{2}$ fathoms water, over sand and mud bottom, with the flagstaff bearing between 304° and 315° .

Tides.—It is high water, full and change, at 9h. 5m. (approximate); springs rise $6\frac{1}{2}$ feet, neaps $4\frac{1}{2}$ feet, and neaps range 2 feet. There is no perceptible tidal stream in the roadstead.

Town.—The town has very little trade, but a number of native passengers embark and disembark during the fair season; in 1901 the population was 4,161.

Communication.—The steamers of the British India Steam Navigation Co. call weekly and there is a post and telegraph office at Baruva. A road connects the town with the trunk road about $2\frac{1}{2}$ miles inland.

Supplies.—Fresh provisions can be obtained in abundance; also good water.

Landing.—The natives assert that landing can always be effected except in the heaviest weather, and that often when it is unsafe to land at Gopalpur there is no danger at Baruva. Masula boats are always available, and flag B of the International Code is the signal for a boat.

Between Baruva and Gopalpur, about 30 miles to the northeastward, the coast is nearly straight and sandy. About 5 miles northward of Baruva and 3 miles inland there is a small range of bare hills which are nearly 600 feet in height. Near Kowita, 10 miles northeastward of Baruva, the land rises gradually from the coast to a height of about 300 feet, forming a wooded table-land which is connected with lower ranges of hills farther back.

The higher ranges are so frequently obscured as to be of little use to the mariner. Other prominent hills are: Ichapur, $4\frac{1}{2}$ miles northward of Kowita, a sharp cone, 514 feet high, surrounded by some smaller hills, which rise nearly 400 feet; and Dandrasi, 676 feet high, $5\frac{1}{2}$ miles northeastward of Ichapur, which from the eastward is a round-topped hill, but from the southward has a long double summit, the western being slightly the higher.

Beacon.—Kowita Beacon, at an elevation of 279 feet, is situated on Kowita Table-land about $2\frac{1}{4}$ miles inland, and about $1\frac{1}{2}$ miles southwestward of it is a high tree.

Raegara, a conspicuous range with four peaks, the highest being 2,914 feet above high water, is situated 15 miles westward of Gopalpur.

Investigator Rock, with a depth of $1\frac{1}{2}$ fathoms over it, lies $\frac{3}{4}$ mile offshore about 4 miles south-southeast of Kowita Beacon; the water is not discolored over the rock, nor does it show by a break.

Sonapur, a small port, 18 miles northeastward of Baruva, is situated at the mouth of a small river; it has a small customhouse, with a flagstaff, painted black, standing on the beach.

Beacons.—An obelisk and a column, painted white, each about 50 feet high, and 20 feet apart, stand on an islet within the mouth of the river.

Currents and winds.—The currents off the coast between Bimlipatam and Gopalpur are mainly influenced by the wind, the tidal stream even at springs having very little effect. In December and January, when northeasterly winds prevail, the current at a mile from the coast sets steadily southwestward, parallel to the coast, at a rate of $\frac{1}{2}$ to $\frac{3}{4}$ knot an hour.

Toward the end of February the wind hauls round to the southwest, and in March blows steadily from that quarter, generally falling light in the morning and freshening during the afternoon to a force of from 5 to 6. The current then sets northeastward, parallel to the coast, its rate close inshore being about $\frac{1}{2}$ knot, but at 10 miles and upward from the coast its rate is frequently from 2 to 3 knots.

Gopalpur, about 11 miles northeastward of Sonapur, and the principal port in Ganjam District, stands on rising ground, and its white houses may be seen from a distance of 12 miles seaward; it is an open roadstead with no shelter, but landing and shipping operations are

possible throughout the year, except occasionally when the surf is too high. Loading and discharging is effected by surf boats.

In the town the most prominent building is that of the British India Steam Navigation Co., on which the word "Gopalpore" is painted in large letters. The limits of the port are defined by white pillars. The port flagstaff, painted white, about 60 yards inshore, is the only one on this coast having a topgallant mast.

Boats can not enter the small stream which flows into the sea immediately northward of the town.

The population of Gopalpur was 2,150 in 1901.

Light.—A fixed white light is exhibited at an elevation of 54 feet above high water from the port flagstaff, 33 feet in height and painted white, situated about 60 yards from the low-water mark, and is visible 10 miles.

Pier.—An iron screw pile pier, formerly extending 960 feet seaward from abreast the port flagstaff, but not outside the line of surf, is little used and rapidly deteriorating; it is partially destroyed.

Storm signals are shown at Gopalpur.

Anchorage.—Anchorage may be obtained in about 8 fathoms water, over sand and mud bottom, with the former pier end bearing 304° and the northern port pillar, or about $\frac{1}{4}$ mile southwestward of that position, in about $7\frac{1}{2}$ fathoms.

Vessels working cargo usually anchor in line with the pier; there is a patch of hard ground 800 yards eastward of the pier, which should be avoided. In the windy months, April to July, anchor in 9 fathoms, with a good scope of cable.

Ballast must be discharged outside the 12-fathom contour line.

Tides.—It is high water, full and change, at Gopalpur at 9h. 40m.; springs rise $6\frac{1}{2}$ feet, neaps $4\frac{1}{4}$ feet, neaps range about 1 foot.

The soundings at Gopalpur are reduced to the March tides; there is 1 foot more water in November, as the mean level of the sea is 1 foot higher in November than in March.

Town.—The small town, which stretches back for about $\frac{1}{2}$ mile from the pier, had a population of 2,150 in 1901.

Communication.—The British India Co.'s steamers run weekly to Madras and Colombo, calling at coast ports, and fortnightly to Calcutta and Bombay; also to Rangoon direct, carrying large numbers of emigrant coolies. There is a station of the East Coast Railway at Berhampur, about 7 miles inland. A canal and a post and telegraph office in the town connects Gopalpur and Ganjam, thence by Chilka Lake to Puri.

Supplies.—Only small quantities can be obtained of fresh meat, bread, and vegetables; the water, from wells, is insufficient for shipping.

Hospital.—There is no hospital accommodation for seamen nearer than Berhampur, but emergency cases will always be admitted into the local fund dispensary.

Quarantine.—A vessel with cholera, smallpox, or other epidemic disease on board, must inform the boarding officer at the earliest opportunity. There are special rules relating to quarantine at Gopalpur, copies of which are supplied by the boarding officer.

Trade.—The principal exports are grain, pulse, hides, skins, sal timber, hemp, coir manufactures, oilseeds, myrabolams, and dried fish; and imports, sugar, piece goods, apparel, jute manufactures, liquors, matches, kerosene oil, cotton twist, and metals.

Winds.—The southwest monsoon breaks about June 15. Winds constantly blow along shore near Gopalpur in March and April; these winds farther north are occasional only, and the first intimation of them is the absence of any lull in the sea breeze at night; they cause an unpleasant sea for boats, and after blowing about three days subside quickly.

Strong winds are frequent off the land between Gopalpur and Palur Bluff, but cyclones do not appear to pass over Gopalpur Hills.

Currents.—The currents usually set with the prevailing wind. About the middle of January the northeasterly current begins, and by the middle of February it sets steadily east-northeast, running $\frac{1}{2}$ knot an hour close inshore and increasing up to $1\frac{1}{2}$ knots at 12 miles off the coast. At the latter distance its direction is about northeast by east or inclined toward the land, which should be guarded against.

The northeasterly current continues to run until July, when the southwesterly current begins and gradually strengthens; it sometimes runs over 2 knots an hour. Between March and August, owing to the displacement of sand along this coast, all the river mouths have narrow spits trending northeastward from their entrances.

Berhampore, 8 miles by road in a west-northwest direction from Gopalpur, had a population of 25,729 in 1901 and is a station on the East Coast Railway.

Hills.—Mansurkota Hill, rocky, isolated, and 165 feet high, is situated $2\frac{1}{4}$ miles northward of Gopalpur, and shows over the sandhills.

Two remarkable isolated hills are situated about 8 miles northward of Gopalpur; Londabans, the eastern hill, is 570 feet high, and presents a conical sugarloaf shape from every direction.

Rushikulya River, about 115 miles long, is utilized for irrigation purposes by a series of works, but neither it nor the canals are used for navigation.

Ganjam, at the mouth of Rushikulya River, 12 miles northeastward of Gopalpur (there are several small fishing villages between), was formerly the capital of the district; it stands with the remains

of an old fort on rising ground, but to the north the country is low and malarious.

There is a flagstaff with some white buildings near it, and the cemetery wall and north boundary pillar are generally visible in the morning; $2\frac{1}{2}$ miles northeastward of the cemetery are three remarkable clumps of casuarinas, which are perhaps the best guide to the place.

Owing to the heavy surf outside and shifting banks it is never likely to be used as a port, and its chief land trade consists in the export of rice to Orissa; the collector of the district resides at Chatrapur, about 5 miles westward of old Ganjam, and the bungalow is conspicuous from seaward.

Anchorage.—The best anchorage, in a depth of $4\frac{1}{2}$ fathoms, is with the flagstaff bearing 270° ; the holding ground is very good.

Town.—The town had a population of 4,397 in 1901, but most of the once handsome buildings are in ruins and very little of it is visible from seaward.

Communication.—Ganjam is a station on the East Coast Railway.

Coast.—Palur Bluff, about 6 miles northeastward of Ganjam, is 580 feet high, backed by Kujidaba Peak, a saddle-shaped mountain 1,114 feet in height, and forms a bold northeastern termination on the coast to the high ranges of Ganjam District. The bluff is about 1 mile southward of the southern end of Chilka Lake, which is the southern part of Mahanadi River Delta.

A low beach of sandhills, backed by a little cultivation and grazing ground, stretches 33 miles northeastward from Palur Bluff to Chilka Mouth, the entrance to Chilka Lake. On this low coast there are few marks which can be identified from seaward; the most conspicuous is Mita kua Bungalow, a small white stone building, on a sandhill close to the sea, and 20 miles from Palur.

Beacon.—A beacon stands close to the sea, 13 miles northeastward of Palur.

Chandiko Mountain, 1,517 feet high, 16 miles northward of Palur and on the western shore of Chilka Lake, stands out somewhat from the high ranges behind the lake, and from the southward shows as a double peak.

Danai, a prominent sharp peak, is 1,892 feet high and $21\frac{1}{2}$ miles north-northwestward of Mita kua.

Puri District—Boundary.—The boundary between Madras Presidency and Bihar and Orissa Province is at the southwestern end of Chilka Lake and is also the western extreme of Puri District, which has a coast line of about 65 miles and includes Puri Port.

Chilka Lake, a pear-shaped expanse of water, about 37 miles in length, 13 miles in greatest breadth at its northern end, and barely averaging 4 miles at its southern part, is separated from the sea by a

long sandy ridge, in places a little more than 200 yards wide; its average depth is from 3 to 5 feet, and in no part is it much more than 6 feet.

The tidal stream, which rushes through the opening connecting it with the sea, keeps the water brackish during the dry season, from December to June, but when the Bhargavi and Daya Rivers, which flow into it, come down in flood the salt water is driven out, and it becomes a fresh-water lake.

On the west and south it is walled in by lofty hills, but to the north it disappears in endless shallows, sedgy banks, and islands just above the surface. Nulbunno Island, a reed forest, about 5 miles in circumference, occupies its center, and on the eastern side are several islands; waterfowl of all kinds are very abundant in every part.

The lake is connected with Rushikulya River by a tidal canal 7 miles long, which is navigable throughout the year by flat-bottomed vessels; large quantities of grain and salt are exported in this manner. Difficulty is said to exist in maintaining an outlet from the lake to the sea.

Rambha, an important village at the southwest end of Chilka Lake, has an extensive trade with Orissa, from which large quantities of rice are imported, by means of peculiar boats built of flat planks, and with Rangoon, to which prawns are exported. In 1901 the population was 4,028. A steam launch plies between Rambha and the northeast end of the lake, but the canal to Ganjam and Gopalpur is lessening the trade of Rambha.

Chilka Mouth, the entrance to Chilka Lake, is small, not easily seen, and has about 3 feet water on the bar in the dry season; and probably more during the rains, but the surf is then so high that the entrance is not used, cargo being taken either to Gopalpur or Puri. At the entrance, shallow water and breakers extend about 800 yards offshore, there being depths of 6 to 8 fathoms close outside them; during a period of 50 years from 1840 the entrance moved 3 miles east-northeastward.

Babeswal Temple, about 6 miles west-southwestward of Chilka Entrance, is sometimes visible among the trees; it is black, and similar in shape to Puri Temple, but is very small.

Tides.—It is high water, full and change, at Chilka Lake entrance at 9h. 10m.; springs rise $4\frac{1}{2}$ feet, neaps 3 feet, neaps range $1\frac{1}{2}$ feet.

Harchandi Temple, $\frac{3}{4}$ mile inland and 4 miles east-northeastward of Chilka mouth, stands on a sand hill, and resembles Puri Temple, but is much smaller.

Depths offshore.—Between Gopalpur and Puri the coast is free from outlying dangers; the 10-fathom contour line is generally from 1 to $2\frac{1}{2}$ miles from the coast, but it extends to 4 miles off for a distance of about 6 miles eastward of Mita kua Bungalow; and

there are several 10-fathom patches within 6 miles southeastward of Puri; the 100-fathom contour line is 24 miles off Gopalpur and about 15 miles off Puri. The bottom near the coast is sand, between depths of 10 and 23 fathoms it is sand and mud, and over 23 fathoms usually mud.

Puri, locally known as Jagannath (Juggernaut), is one of the most sacred places of the province, which for 2,000 years has been the holy land of the Hindus, and is situated on the coast and on a low sandy ridge $8\frac{1}{2}$ miles east-northeast of Harchandi Temple.

The famous Jagannath Pagodas are at the back of the town, 1,400 yards from the sea, on lowland covered with small trees, and consist of three circular towers, decreasing in size eastward, each crowned by a white dome. The western pagoda is 192 feet in height; the three pagodas are in line when bearing 275° , and are seen separately on a northerly bearing; they are conspicuous in the forenoon from seaward. The western side of the pagodas appears perpendicular, while the eastern side slopes.

The port boundary pillars are painted black and white in horizontal bands.

Light.—From a pedestal surmounting a house, the whole 33 feet in height, painted white, and situated on the parapet wall of the circuit house, which has "Pooree" painted in black letters on it, an occulting white light is exhibited at an elevation of 44 feet above high water, visible 11 miles. (For details see Light List.)

A flagstaff, painted white, is located on the coast and close to the port office.

Storm signals are shown at Puri port office flagstaff.

Anchorage.—In fine weather anchorage may be taken up off the town in from 7 to 8 fathoms of water, over good holding ground; the best berth is said to be in a depth of 7 fathoms with the light-house bearing 6° and the southwest port pillar 321° . The bottom is nearly all clay, and the depths decrease gradually from 20 fathoms to 7 fathoms, and then rapidly to the beach, so that the lead should be constantly used.

An old ballast ground in 10 fathoms, $2\frac{1}{2}$ miles, 119° from the flagstaff, should be avoided.

Tides.—It is high water, full and change, at Puri at 9h. 15m.; springs rise $4\frac{1}{2}$ feet.

The mean level of the sea is 1 foot higher in November than in March; the soundings on the plan of Puri are reduced to the March tides.

Town.—The sea front of Puri is about 1 mile long, and the Government offices, whitewashed and conspicuous, stand on the beach, with a sandy ridge between them and the town; the site is salubrious.

as the monsoon blows on it fresh and cool from the sea, but during the rains it is not so healthy.

Puri, being the seat of the shrine of Jagannath and a great resort of pilgrims, is a city of lodging houses, and, excepting the principal avenue which leads from the temple to the country house of Jagannath, has mean and narrow streets, the houses being built of wattle covered with clay, and raised on mud platforms about 4 feet high. The population was 49,334 in 1901, but that number is greatly increased by pilgrims at certain times.

The diseases which arise from overcrowding of the pilgrims are aggravated by the faulty drainage, and a complete scheme is in contemplation; other methods have also recently been taken to improve the sanitary conditions.

Communication.—Steamers of the British India Steam Navigation Co. call occasionally, and a branch railway runs to Kurda Road, where it connects with the East Coast Railway. There is a post and telegraph office in the town.

Supplies are scarce and very expensive, but sheep, fowls, eggs, rice, flour, sugar, and vegetables can generally be obtained. Fresh water may be procured, but it is not recommended.

Landing.—The usual landing is at the flagstaff; ships' boats can not land at Puri in the finest weather, but masula boats can be obtained.

Vessels load and discharge by surfboats.

Hospital.—Seamen are received, if absolutely necessary, at the municipal dispensary hospital.

Trade.—The only export is rice, of which a quantity is exported annually to Ceylon and Cochin; the imports are Government's stores, treasure for the temples, and gunny bags from Calcutta.

Weather.—Cyclonic storms occur late in April, in May, and June, but rarely in July; they also occur in October and November. The swell on the beach generally gives good warning of the approach of a cyclonic storm.

The fine weather season is from the middle of November to the middle of March, when the sea breeze sets in about noon and blows moderately until 9h. p. m.; the land wind then follows until daylight, after which the wind is variable till noon.

After the middle of February the sea breeze sometimes lasts all night and blows freshly for 3 days, causing a sea which makes boat work inconvenient. The rainy season is from May to November, and August is the wettest month, with an average rainfall of about 14½ inches, the annual fall being nearly 40 inches.

Coast.—From Puri the coast trends in an east-northeast direction for 23 miles to Tundaha and thence more northerly for 11 miles to Devi Point, northward of which is Devi River mouth, one of the

branches of the Mahanadi. The coast is sandy, with bare sand hills 20 to 70 feet high, and groups of trees inside them. It is so low that it must not be approached at night or in hazy weather, but it being free from off-lying dangers, it may be safely navigated by using the lead and not shoaling the water to less than 12 fathoms, bearing in mind that there are depths of 8 fathoms close outside the breakers.

Caution.—Reliance can not be placed on estimating the distance of the coast by the eye, as owing to the fine sand haze the land is often much nearer than it appears to be. At night the sandy beach blends with the water, and the tops of large trees showing over the hillocks appear very distant on an indefinite horizon. This is especially the case on moonlight nights, when vessels are tempted to keep near the land in order not to be taken past their ports by the currents. In the southwest monsoon a heavy surf breaks on the coast, and should a vessel touch the bottom she is almost certain to be lost.

Baleswur Temple, 7 miles eastward of Puri and $\frac{1}{2}$ mile inland, is a small black pagoda-shaped building with trees around it; only its upper portion is visible from seaward.

Kusbhadra River.—About 14 miles from Puri is Kusbhadra River entrance, which is a very shallow stream; there are breakers, but there is no shoal at its entrance. Ramchaudi, a small temple with two palms, is on the land about $\frac{1}{4}$ mile northward of the river entrance.

Black Pagoda (Kanarak), situated 3 miles northeastward of Kusbhadra River entrance and $1\frac{1}{4}$ miles inland, although in a ruinous state, is most prominent, being about 130 feet high, standing on low land with a few trees at its base and presenting the appearance of the gable end of a house with a roof sloping westward; from the northeastward it shows as a black pyramid, and is one of the most exquisite memorials of sun worship in India.

Tundaha Obelisk, 15 feet high, is situated on the sandhill within the beach $9\frac{1}{2}$ miles eastward of Kusbhadra River entrance.

Cuttack District, commencing at the Prachi River, has a coast line of about 70 miles; Devi and Mahanadi Rivers and False Point anchorage are on this stretch of coast.

Prachi River mouth is situated 1 mile eastward of Tundaha Obelisk; the stream is shallow.

Nulyasai, a conspicuous fishing village on the sandhills, lies on the coast about 6 miles northeastward of Tundaha Obelisk.

Devi River, one of the largest branches of the Mahanadi and formed by the junction of the Great and Little Devi, flows through a low level district, and reaches the sea after passing westward of a long, narrow sand spit, which terminates in Devi Point. The country within the river entrance is a dense, swampy jungle, with no inhabitants.

The locality is indicated by Nulyasai Village, and Balijori Obelisk, 15 feet high, a trigonometrical station on the sandhills, $2\frac{1}{2}$ miles northward of Devi Point; on closing the river the breakers on the bar may be seen, and, from a sufficient height, the river itself over the sand spit.

Central Sand.—The outer bank, from about $1\frac{1}{2}$ miles eastward of Devi Point, trends northward and northwestward to Central Sand, on the northern side of the entrance; it does not always break in fine weather, and its edge is more than 1 mile from the line of coast, so that care must be observed in the approach. Balijori Obelisk, bearing westward of 337° , leads eastward of the bank; and in passing, the water must not be shoaled to less than 9 fathoms.

Entrance—Depth.—In 1889 there was a passage into the river, 700 yards in length, and with a depth of 8 feet at low water, through a gap in the breakers about 200 yards wide. The entrance of the passage was then about 1.1 miles 79° from Devi Point, and the direction of the passage was 315° .

From within the breakers on the port hand, a 259° course led into the river with depths of 14 to 30 feet. In the southwest monsoon the entrance probably breaks right across.

Landing.—In case of necessity there is a landing for boats, with southerly winds only, in the bight northward of Central Sand, about $1\frac{1}{4}$ miles northward of Devi Point.

Outer anchorage.—There is anchorage with westerly winds off Devi River in $8\frac{1}{2}$ fathoms, sand and mud, with Balijori Obelisk bearing 342° , and the center of the gap in the breakers 277° ; or with onshore winds, in 8 fathoms, with the obelisk 316° , distant 1.6 miles.

Inner anchorage.—There is good anchorage inside in 3 fathoms, with Devi Point bearing 56° , distant about 1,200 yards. Small steamers, drawing 8 to 10 feet, might enter the river; at present there is little trade, light winds making the entrance difficult for sailing vessels in the fine weather season.

Tides.—It is high water, full and change, inside Devi River mouth at 8h. 54m.; springs rise 9 feet, neaps $6\frac{1}{2}$ feet, and neaps range 2 feet.

Coast.—From Devi Point the coast curves 17 miles north-northeastward to Jotdar River entrance, and consists of low sandy beach with hillocks 15 to 20 feet in height. At two places the coast is so low that it is probable the sea in heavy weather washes over it into the backwater behind.

Hurrichpur River.—The shallow mouth of the Hurrichpur Branch of Devi River is 4 miles north-northeastward of Devi Point, and about $1\frac{1}{2}$ miles up the Hurrichpur is the small post town of that name. The entrance to this stream is not visible from seaward.

Magarkhira Tanda Beacon is situated $10\frac{1}{2}$ miles north-northeastward of Devi Point.

Jotdar River.—The Jotdar mouth is shallow and there are always breakers across it; in 1889 its position was marked by a ridge of high sandhills.

Coast.—From Jotdar River the coast trends northeastward for 13 miles to Mahanadi Point, which is nearly 2 miles eastward of False Point Lighthouse, and thence the eastern coast of Dowdeswell Island bends northward. Patakund River is very shallow; its entrance is nearly 6 miles from Jotdar entrance, and northeastward of Patakund River the land is low. Senkud Obelisk, 15 feet high, is situated on the west side of Patakund River entrance.

Depths offshore.—Between Puri and Mahanadi the 10-fathom contour line is 4 miles offshore seaward of Black Pagoda, $1\frac{1}{2}$ miles near Devi River, and $6\frac{1}{2}$ miles southeastward of Senkud Obelisk, closing the shore to $3\frac{1}{2}$ miles eastward of Mahanadi Point. The 100-fathom contour line averages 16 miles offshore until, eastward of Devi River, it bends away from the land. The bottom under 10 fathoms is sand; from 10 to 30 fathoms, dark mud; and over 30 fathoms, soft gray mud.

Mahanadi River—Entrances.—The south entrance to Mahanadi River, which is about $4\frac{1}{2}$ miles northeastward of Senkud Obelisk, has a course of about 510 miles and receives many tributaries. The land at the entrance of the Mahanadi and near False Point Lighthouse is low, intersected by numerous creeks, and the sea face forms long narrow islands, joined by shoal ground, which are constantly altering.

It had, in 1889, a long line of heavy surf extending right across and 1 mile seaward of it; and the north entrance, $1\frac{1}{2}$ miles eastward of False Point Lighthouse, also had heavy breakers extending across it. The rivers of the delta are subject to frequent changes.

Depths.—Inside Mahanadi River entrance the navigable channel appears to be about 400 yards in breadth, with depths of 12 to 30 feet.

Cuttack City, the headquarters of the Cuttack District and of the Orissa Division, is situated on the peninsula formed by the bifurcation of Mahanadi River, where the Katjuri River leaves it; it became an important place in the tenth century, and the ancient fort, of Hindu origin, is one of its most conspicuous monuments.

In addition to the usual public offices, the chief public works are the stone embankments by which the city is protected from inundation; it has also several important educational institutions, and is noted for its filigree work. In 1911 the population was 52,528.

Communication.—River steamers with cargo boats in tow connect the port with the coasting steamers at False Point, a distance of 75

miles via Iumboo and the Iumboo and Kendrapara Extension Canal. Cuttack has railway communication.

Hospital.—The general hospital has beds for 60 male patients.

False Point Light.—Within the north entrance to Mahanadi River and $1\frac{1}{2}$ miles westward of Mahanadi Point, is a stone lighthouse, 132 feet in height, painted reddish-brown, with a large white 10-pointed star on its southeastern side, from which is exhibited at an elevation of 127 feet above high water an occulting white light visible 17 miles. (For details see Light List.)

In January, February, and March the light is occasionally obscured by fog on the land, which sometimes causes it to show a deep red color; during these months, when approaching False Point, the lead should be consistently used and the water not shoaled to less than 11 fathoms, which depth is about 3 miles from the shore. A good guide is to examine the bottom, and if it is sand mixed with mud the vessel's head should be kept seaward till daylight.

NOTE.—In the northeast monsoon, or with northeast winds, False Point should be avoided by sailing vessels, it being then a lee shore with generally a westerly current in the vicinity.

False Point Anchorage.—A tongue of land extends northeastward from False Point Lighthouse for a distance of 3 miles, nearly meeting Turtle Point, the south extreme of Dowdeswell Island (Nurrea banga Nassi), which island, with a spit at its north end that dries, stretches about $4\frac{1}{4}$ miles northward, and is sometimes joined to the mainland. The coast is a range of small sand hillocks, averaging in height from 6 to 8 feet above high water, and covered with grass and scrub.

The anchorage northward of Dowdeswell Island and in the bay westward of its northern part is known as False Point Anchorage, which is safe, roomy, and landlocked by islands and sandbanks, and has two navigable buoyed channels.

Reddie Point.—The end of the spit, which dries at half ebb, extended about 200 yards northward and 1,800 yards westward of the north extreme of Dowdeswell Island in 1909, but it is continually changing; the northwestern end of this spit is known as Reddie Point.

Huki-tala, on the western side of Dowdeswell Island, is the harbor-master's station, but some of this part of the island was washed away, and from the latest information only the refuge house, a large stone building with a flagstaff, and a few coconut palms were standing; the house is easily distinguished from seaward.

Signal staff.—The signal station of the coast telegraph is about 200 yards westward of the refuge house at Huki-tala; vessels can communicate by the International Code. The staff is 73 feet in

height, and consists of a lower mast and topmast, with a yard, all painted white.

Storm signals are shown from the signal staff at Huki-tala.

The telegraph station is located at Huki-tala. Meteorological reports are sent to this station from Calcutta.

Western shore.—The inner shore of the bay, westward of Dowdeswell Island, embracing Plowden Island, Jambu River entrance, and toward Temple Point, is principally mangrove swamp. Temple Point is a projecting point of trees, $1\frac{1}{2}$ miles north of the Jambu River entrance, and $3\frac{1}{2}$ miles westward of Huki-tala.

From Temple Point to South Broni River, $3\frac{1}{2}$ miles northward, the land is low, covered with grass and scrub, with occasional patches of mangrove swamp, fringed with sand, which forms the high-water line. Further northward, the sandhills are more elevated, and the mouth of Broni Mohan Creek forms a conspicuous gap between high sandhills.

Channels.—Two channels, which have an entrance common to both, immediately northward of Reddie Point and a bar westward of it, lead inland; Bakud Creek, the southern channel, is a short, deep branch of Mahanadi River; Jambu River, the northern channel, leads to Jambu Settlement or Location. Tidal creeks, navigable by country boats throughout the year, connect False Point with Dhamra and Brahmani Rivers to the northward, and with Devi River to the southward.

Depths.—There are depths of from 12 to 17 feet in the entrance channel northward of Dowdeswell Island shoaling to the bar on which the depths are from 1 foot to 5 feet, and at high water cargo boats and small steamers enter without difficulty. In Bakud Creek the depths are from 1 foot to 5 feet, and in Jambu River from 6 to 20 feet in mid-channel; the latter is available for vessels of 10 feet draft at high water.

Beacons and marks.—Reddie Point and the spit extending northward of Dowdeswell Island are continually changing; the beacons marking the point and spit are shifted as the changes occur. The positions given below are from the latest information, but no reliance should be placed on them.

Reddie Beacon, 50 feet in height, painted black, with an oblong basket at a topmark, is situated about 1,700 yards southeastward of Reddie Point, and $1\frac{1}{2}$ miles 7° from Huki-tala Signal Staff.

Prince Arthur Beacon, consisting of a pole and cage painted white, is on Prince Arthur Point, on the western side of Dowdeswell Island, about 1 mile southward of the refuge house.

A beacon stands at nearly 400 yards southeastward of Plowden Point.

A beacon, painted white, is situated on Black Point, the northeast end of an islet on the southern side of the entrance to Jambu River.

There is a remarkable tree known as Temple Tree, the highest in the vicinity, with a pole and black basket projecting from its summit, nearly 1 mile west-northwestward of Temple Point.

On the northern entrance point of South Broni River is an upright spar with topmast and black cage.

Buoys.—Fairway Buoy, painted black and white in horizontal bands with staff, lies in 30 feet water, about $1\frac{3}{4}$ miles 21° from Reddie Beacon.

On the southern side of the entrance channel are:

Outer Spit Buoy, painted black and surmounted by a staff and cage, moored in about 17 feet water, 800 yards northwestward of the north point of Dowdeswell Island.

Inner Spit Buoy, conical and painted black, moored nearly 1,600 yards west-northwest of the north point of Dowdeswell Island.

Flat Buoy, conical and painted black, about $\frac{1}{2}$ mile westward of the preceding buoy.

On the western side of the entrance channel is:

Inner Ridge Buoy, painted red and surmounted by a staff and triangle, about 800 yards south-southwestward of the preceding buoy.

For the beacons and buoys marking the inner channels, see the chart.

NOTE.—All these buoys are moved as changes occur in the depths.

Outer anchorage.—The outer anchorage, in about 26 feet water, is $\frac{3}{4}$ mile northwestward of the north point of Dowdeswell Island, with the beacon on Reddie Spit and Huki-tala signal staff in line bearing 187° ; or in 33 feet, at about $\frac{1}{2}$ mile eastward of the Fairway Buoy, with Huki-tala signal staff bearing 197° .

There is also anchorage anywhere between the buoys marking the channel in 23 feet and less water, according to the draft.

Steamers can anchor about 200 yards westward of the Fairway Buoy.

Small vessels can anchor in a deep hole, nearly $1\frac{1}{2}$ miles long, and situated southward of Reddie Point, and to the westward of the spit, the depths being from 9 to 14 feet.

The channels in the harbor are liable to change and inclined to silt up.

Ballast must be discharged outside the limits of the port.

Directions.—From the southward, having made False Point Lighthouse, the water should not be shoaled to less than 10 fathoms until the lighthouse bears 247° , distant about 6 miles, when steer north until the refuge house is abeam, bearing 270° , when 321° should lead to the fairway buoy.

With strong southerly winds the flood stream sets toward the coast about Satbaia, and vessels from the northward must guard against it.

For the inner anchorage pass northward of the Outer Spit, Inner Spit, and Flat, black buoys, and eastward of the Inner Ridge red buoy (taking care to guard against an eddy extending from Reddie Point to the 3-fathom line). It must be remembered that Reddie Point does not always show, as the spit of which it is the extremity only dries at a half ebb.

If bound to Jambu leave the beacons on the port hand. The channel leading to Bakud Creek is marked with buoys painted black on the port and red on the starboard hand entering.

In navigating these channels the services of a local pilot should be obtained, as they alter from time to time, and changes are frequently made in the position of the buoys and bamboos which denote the fairway.

With a strong flood stream (which may be noticed by its drifting a vessel rapidly northward) it is best to steer in on a southerly course, turning to port (east and northeastward) so as to stem the stream before anchoring. Steamers steering toward Reddie Point and attempting to turn to starboard or through southwest and northwest, with the flood stream running, have been rapidly swept across the channel to the westward and grounded on the shoals extending from Temple Point.

Boat channels.—From the inner anchorage, boat channels, winding through mud banks and partially buoyed, lead to Bakud Creek and Jambu River. There is also a channel, sometimes available for boats through mud flats and mangrove, leading to False Point Light-house, the banks on either side being marked by bamboos.

Tides.—It is high water, full and change, at Huki-tala at 9h. 18m.; springs rise 7 feet, neaps 4 feet, neaps range 2 feet. The range of tide is much affected by the fresh water out of the numerous creeks and also by the prevailing winds; the highest tides occur during the southwest monsoon, the lowest in the dry season.

Tidal streams.—The tidal streams within the harbor set fairly through the several channels, and the rate at springs averages 2 knots an hour. After heavy rains, when the freshets come down Bakud Creek and Jambu River, the ebb stream, which runs out around Reddie Point, sometimes attains a rate of 4 or 5 knots an hour.

About $\frac{1}{2}$ mile eastward of Reddie Point, the flood stream sets north; at the fairway buoy northwest; whilst midway between the buoy and Reddie Point, it sets west-southwest. Great attention, therefore, is necessary in entering the port with the flood stream.

In the offing, the flood sets northeast, the ebb southwest, each at a rate of about 1 knot an hour; but the rate is much influenced by

the prevailing wind, so that the flood stream, together with the current in the southwest monsoon, attains sometimes a rate of 4 knots.

Jambu location, consisting of public works department bungalows, is situated on the left bank of Sunta Creek, and is conspicuous from the anchorage. The telegraph station has been moved to Jambu Canal Lock, and the port and customs authorities reside at Huki-tala.

Communication.—Steamers of the British India Steam Navigation Co. from Calcutta, Madras, and coast ports usually call weekly. There are post and telegraph offices at Huki-tala on Dowdeswell Island, and at Jambu Canal Lock.

Supplies.—Provisions are scarce and expensive; sheep and vegetables can be obtained from Cuttack, and from villages in the neighborhood; but it is better to obtain all provisions from Calcutta by steamer. Good water can be procured at the canal lock, about 1 mile up Jambu River, by using boats. Firewood is plentiful and cheap.

Trade.—The port is open throughout the year, but its importance has not been appreciated till comparatively recent years. The exports consists of rice, horns, hides, and oilseeds, and imports principally of European stores.

False Bay.—The coast from Broni Mohan Creek trends northeastward for $20\frac{1}{2}$ miles to Maipara Point, at Maipara River entrance, forming False Bay; it is moderately high, consisting of sand hills, but from Maipara Point northward it is quite flat.

Satbaia Sandhill, on the coast about $12\frac{1}{2}$ miles northeastward from Broni Mohan Creek trends northeastward for $20\frac{1}{2}$ miles to the eastern end, and affords a good landmark.

In the southern part of False Bay, the bottom is soft olive green mud, with regular depths, decreasing gradually to the shore; but in northern part of the bay, the bottom changes from soft mud to a mixture of sand and mud, with rotten stones and broken shell toward the southern edge of the sand banks, which extend seaward from the mouth of the Maipara River and Palmyras Point.

Caution.—On nearing False Point from the eastward the water shoals gradually, but in approaching the shoal ground extending eastward from Palmyras Point from the same direction the water shoals suddenly from 13 to 9 and 4 fathoms.

Maipara River, the southern branch of the Brahmani, enters the Bay of Bengal about 5 miles southward of Dhamra River. Bansgarh River, a tidal creek of the Maipara, runs in a southwest direction parallel to the coast till it enters the sea by Broni Mohan Creek. Maipara River is deep, but its entrance is blocked by flats which can only be crossed by boats at half tide in smooth water; it is fre-

quented from November to March by native craft engaged in the rice trade.

Long Sand, on which the sea breaks heavily, is 3 miles in length in a northeast and opposite direction, its southwest end forming the eastern entrance point to Maipara River.

Anchorage.—With strong northwesterly winds there is anchorage in a depth of 7 fathoms over mud and sand, about $2\frac{1}{2}$ miles south-eastward of the northern end of the sand hills on Maipara Point.

Palmyras Shoals extend generally 8 miles eastward of Shortt Island Lighthouse, at Dhamra River entrance, and have depths of from $\frac{1}{2}$ fathom to 5 fathoms over them. From the southern extreme of the eastern portion of the shoals, with a depth of $4\frac{1}{2}$ fathoms, Shortt Island Lighthouse bears 314° , distant $8\frac{1}{2}$ miles, and from the northeastern extreme of the shoals, with a depth of $3\frac{1}{2}$ fathoms, the lighthouse bears about 254° , distant $6\frac{1}{2}$ miles.

Caution—Tidal streams.—The tidal streams set over Palmyras Shoals at a rate of 2 knots at springs, and must be guarded against when navigating in the vicinity. On the northeastern side of the shoals the flood stream sets about northwest and the ebb south-east. At the southern end of the shoals the flood sets north and the ebb south.

Palmyras Point is the northeastern extreme of the lowland which separates Maipara and Dhamra River mouths. A mud bank fringes this coast, and dries seaward at low water for a distance of 2 miles.

The point is covered with dark jungle, and is difficult to distinguish; the surrounding land is low, with a few palmyra trees on it.

Budara Pillar is situated about 1 miles south-southeastward of the point.

Dhamra River, the most important of the navigable rivers of Orissa, forms the northern exit of the united streams of the Brahmani, Kharsua, and Baitarani Rivers. The inner bar of the river changes both in depth and position; but the outer bar, to the north of Shortt Island, maintains its position and depth of water fairly well.

About 9 miles from its mouth the Dhamra forms two branches; the Baitarani, on which are situated the towns of Chandbali and Jajpur, following a westerly direction; and the Brahmani, taking a southwesterly direction and passing Cuttack. About 6 miles above the Baitarani junction, Brahmani River connects with the Maipara, and about 3 miles higher receives Kharsua River, which again connects with the Baitarani above Jajpur.

Shortt Island.—This island has changed considerably. In June, 1914, the southern prong had been completely washed away. The island was then about 1.4 miles long in a north-northwest and south-southeast direction, and about 800 yards broad at its southern part,

tapering to less than 400 yards at its northern end. The old light-house was nearly 400 yards out to sea, to the eastward.

Light.—On Shortt Island a fixed white light is exhibited at an elevation of 61 feet above high water, from a flagstaff 63 feet in height and painted black, and should be visible 12 miles.

The flagstaff from which the light is shown stands $\frac{1}{4}$ mile to the northward of the south part of the island.

Beacon.—A beacon, surmounted by a black basket, the whole 50 feet high, stands on Shortt Island.

Channels.—There were two entrances to the river, the South and North Channels, but the latter was closed in 1901. The South Channel, about $\frac{3}{4}$ mile wide at its outer part, with a shoal on which the depths are from 8 to 12 feet in mid-channel of the outer bar, passes about $\frac{1}{4}$ mile northward of Shortt Island, where it is narrowed to that distance between banks, with less than 10 feet over them on either side.

About 3 miles farther in it passes between extensive flats of sand and mud, which dry at low water, and about 2 miles farther west is the inner bar, from which to Dhamra Village, situated on the north bank, where the river is divided into two channels by Kalibhanj Island, the distance is 5 miles.

Depths.—The least depth to be passed over on the outer bar (1914) is 10 feet at low water and about 19 feet at high water springs, but on the inner bar not more than 9 feet is charted between the buoys.

To Chandbali, up Baitarani River, the least depth is about 7 feet at low water, and 16 feet at high water springs, on Jhuta Bar, about $1\frac{1}{2}$ miles above the junction of the Baitarani with the Dhamra. The draft of the steamers trading to Chandbali is about 13 feet; vessels drawing 15 feet could reach that port at high water, spring tides, and 12 feet at high-water neaps.

Kanika Sand.—Kanika Sand, 5 feet high, and said to be extending, is situated on the northern side of the channel more than 4 miles westward of Shortt Island. A flat of sand and mud, which dries at low water, stretches 1 mile eastward, northward, and westward of Kanika Sand.

Chandipal Beacon, the triangular top of which shows over the trees, is situated about 800 yards northward of the low mud point forming the north entrance point of the river, and $2\frac{1}{4}$ miles westward of Kanika Sand.

Kalibhanj Island, the east point of which is 2 miles westward of Palmyras Point, is $4\frac{1}{2}$ miles in length in an east and west direction, and about $\frac{3}{4}$ mile in greatest width; with the shoal water extending eastward of it, as far as Palmyras Point, it divides Dhamra River into two channels, the northern being navigable.

A perch stands on the northern side of the east end of the island.

Dhamra Village, on the north bank of the river, 10 miles above Shortt Island, consists of a few straggling houses and a customhouse. A tide pole indicates the depth of water on Chandipal or Inner Bar.

Natai River, which joins the Dhamra River about $\frac{1}{4}$ mile westward of Dhamra Village, is about 200 yards wide and said to be navigable at low water for craft of 8 feet draft.

Buoys.—The channel of the Dhamra River from Shortt Island as far as Kalibhanj is marked by red buoys only, with the exception of black buoy E, which lies about 200 yards northward of north point of Shortt Island.

Red buoys D and C mark the south side of the channel after rounding black buoy E.

Red buoy B is moored about 450 yards southward of the tide pole off Kanika Sand.

Red buoy A, formerly marking northern side of Inner Bar, now lies 900 yards eastward of Low Mud Point.

Outer anchorage.—With strong southwest winds there is good anchorage in a depth of 7 fathoms, with the flagstaff bearing about 210° , distant 4 miles.

Pilots.—There are two native pilots for Dhamra River, one of whom is usually at Shortt Island.

Directions.—The south channel is the only one used, and as the buoys are moved occasionally, on the channel altering, these directions must be used with caution, and it is advisable to take a pilot. In approaching Dhamra River the lighthouse by day or the light by night may be approached, bearing 225° , and, if at the latter time, anchorage taken up when in 6 or 7 fathoms.

South channel.—In rounding Palmyras Shoals do not shoal to a less depth than 15 fathoms until Shortt Island flagstaff bears southward of 236° , when steer for the entrance of south channel, and on nearing it the coast will be seen as a low dark line of trees, with the gap made by the channel southward of Kalibhanj Island bearing about 256° .

Steer about 242° over the outer bar, and pass northward of the black buoy at the northern end of Shortt Island Shoals, having passed which keep more to the southward; pass on north side of buoys D and C and southward of buoys B and A.

From the inner bar the course is about 270° , passing southward of the low mud point southward of Chandipal Beacon, when the distant northwest extreme of Kalibhanj Island should be kept just open northward of Kalibhanj Perch, bearing 274° . Pass the perch at a distance of 200 yards and steer along about 300 yards from the north coast of Kalibhanj Island. When Dhamra Village bears 315° , steer for the middle of the stream and anchor with the village bear-

ing about 337°. Vessels drawing 20 feet water have anchored off Dhamra. In 1911 the depth on Chandipal Bar was 10 feet.

The river above Dhamra should not be navigated without a pilot.

Baitarani River, meaning difficult to cross, enters Balasore District at Batipur Village, and flows southeastward for 45 miles till it joins the Dhamra 9 miles from the sea. The country in the vicinity is largely cultivated with rice, and the river forms the boundary between Balasore and Cuttack.

The entrance to Baitarani River is divided into two channels by Luchinarian Island, which is above $\frac{1}{2}$ mile in length by $\frac{1}{4}$ mile in breadth; the northern is the navigable channel, the southern being only available for boats.

Beacons and buoys.—Beacons stand at various points on the river, and buoys mark dangers; their positions will be seen on the chart.

Jhuta Bar is formed by shoal water extending across the river from the western side of Luchinarian Island to a flat, which dries, stretching about 700 yards northward of Pilot Island, situated about $\frac{1}{2}$ mile to the southward of Douglas Point. In 1911 the depth on Jhuta Bar was only 6 feet.

Pilot Island, southward of Jhuta Bar, is low and about 800 yards long in the direction of the river. Sand flats which dry extend northward and southwestward of it, and there is a narrow boat passage between it and the west bank of the Baitarani River, but the navigable channel, known as Pilot Reach, lies between Pilot Island and the east bank.

From the extreme of the spit extending southwestward of Pilot Island, the river trends around Palmer Point, northwestward of which and on the western side of the river is Sickie Island, a bank which dries at low water.

The navigable channel lies close to the eastern side of the river and, curving westward, crosses to the south bank at Sickie Point, the eastern end of Long Reach.

Long Reach is about 2 miles in length and bends around Borarria Point, which is low; it terminates northward on Hurripur Bar, which has about 8 feet at low water over it.

Hurripur Reach trends northward and the deepest water is in mid-stream; its upper part trends westward around Love Point.

Love Point Bar extends about 800 westward of Love Point and has depths of from 7 to 8 feet over it. The deepest channel is 50 yards from the south bank up Love Reach, until Travellers Bunga-low bears 0° distant about 200 yards, and thence in mid-stream.

Tides.—It is high water, full and change, at Shortt Island at 9 h. 45 m.; at Kanika Bank at 9 h. 30 m.; and at Chandbali at 11 h. 0 m.; at Shortt Island springs rise $9\frac{1}{2}$ feet, neaps 6 feet.

The tides are subject to a large diurnal inequality, which may either accelerate or retard the times of high and low water, sometimes to the amount of an hour or more.

From September to March, inclusive, the night tides are higher than the day tides; in December and January, at springs, the difference is about 2 feet.

From March to September, the day tides are higher than the night tides, and the difference is greatest in June and July, at springs.

A tide gauge is situated about 1,200 yards northwestward of Shortt Island flagstaff; there is a tide pole southwestward of Kanika Sand and another off Dhamra Village.

Chandbali, on the north bank of the Baitarani River, 20 miles from its mouth, has decreased in importance owing to the opening of the Bengal-Nagpur Railway, but still possesses a large trade; it is considered within the port of Dhamra. There is a police station, travelers' bungalow, and customhouse with warehouse; also three landing piers, which have each a depth of 10 feet at their ends. The population of Chandbali in 1901 was 1,826.

Anchorage.—The anchorage, in from 22 to 30 feet, is in front of the town.

Communication.—There is communication with Calcutta by steamer four times a week, and with Cuttack by canal or road.

Supplies of fresh provisions can be obtained at Chandbali in small quantities.

Storm signals are shown from a staff near Chandbali customhouse.

Trade.—The sole export is rice; the imports are piece goods, cotton twist, kerosene oil, salt, spices, and gunny bags. There is only a coasting trade at Chandbali, conducted principally in light-draft steamers; native vessels carry on a small trade in rice during the northeast monsoon.

Guire Point, a sharp point on the south bank of the river, about 600 yards westward of Chandbali, terminates Love Reach. Here the river turns sharply southeastward, and is navigable 2 miles farther for vessels of a draft that can reach Chandbali.

Mahurigaon, situated 2 miles above Chandbali, on the east bank of the river, is unimportant.

CHAPTER IV.

BALASORE, SUNDARBANS, AND CHITTAGONG COASTS, WITH THE HUGLI, MATLA, AND MEGHNA RIVERS.

Balasore District.—The Baitarani River is the southern boundary of Balasore District, which has a coast line of nearly 80 miles and contains the ports of Balasore and Subarnarekha.

Coast.—From Dhamra River entrance the coast trends northward for a distance of 4 miles to the sandy Balisai Point; flats extend well off this coast, and there is a depth of 3 fathoms at from 6 to 7 miles eastward of it. The coast then has a north-northwest direction for 13 miles to abreast of Bidiapur, and is low, muddy, and wooded with small scrub; the 3-fathom contour line is from 4 to 5 miles from this part of the coast, and landing is difficult owing to the softness of the mud.

About 3 miles northward of Bidiapur the coast trends northward, and as far as Kalikoti, $7\frac{1}{2}$ miles from Bidiapur, is flat and faced with low mangroves. Eastward of Kalikoti the 3-fathom contour line is $5\frac{1}{2}$ miles from the mangrove edge, and the bottom is soft, olive-colored mud.

About 2 miles northward of Kalikoti the coast turns to the north-northeastward, and 9 miles farther in that direction is Nauri, with mud and sand flats extending off it, and about halfway between these places a large double pagoda shows out among the trees on north-westerly bearings; the Calcutta Coast Canal to Cuttack runs along a few miles within the coast. At Nauri the coast becomes firm, with higher trees and sand hills, and so continues for 10 miles to Chandipur.

Gammai River, a small stream, enters the sea 1 mile southward of Kalikoti, and another stream debouches just south of Nauri; both are inaccessible at low water to anything but small boats.

At Chandipur is a large white bungalow with a black flagstaff near it, whence low sand hills continue $1\frac{1}{2}$ miles to Burhabalang River Entrance.

The coast near the mouth of Burhabalang River appears from the offing to be sandy and barren.

Balasore Road is resorted to in the northeast monsoon for cargoes of rice, which are brought down Burhabalang River. The largest vessels which ascend to Balasore or receive their full cargo in the river are of about 145 tons.

Light.—A fixed white light is exhibited, at an elevation of 62 feet above high water from Chandipur Flagstaff, 20 feet in height and painted black, and should be visible 10 miles.

Anchorage—Directions.—A vessel of 20 feet draft will find the best anchorage in a depth of 4 fathoms, over a bottom of sand and stiff mud and good holding ground, with Chandipur Flagstaff bearing 304° , distant nearly 7 miles.

Anchorage may also be obtained with the flagstaff bearing 322° , distant about $4\frac{1}{2}$ miles, in a depth of $3\frac{1}{2}$ fathoms.

The anchorage should be approached with the highest part of Nilgiri Hills, about 15 miles inland, bearing about 292° .

Burhabalang River, rising in the Mayurbhanj Hills, after receiving the Gangahar and Sunai Tributaries, flows into the sea at Balasore Road; the river is tidal for a distance of 23 miles, and native craft and steamers of 9 feet draft navigate to the town of Balasore, about 16 miles from the entrance. Jimkhana Bar, about 1 mile below Balasore, extends between sand banks, and has from 1 foot to 2 feet at low water over it.

Entrance channels—Depths.—The entrance to the river, 400 yards in width, is almost closed by a bar extending seaward for about $2\frac{1}{2}$ miles, over which there are two channels. The southern of these, which is about $\frac{1}{2}$ mile in width at its narrowest part, passes southwestward and westward of Elfin Flat, and had a least depth of 2 feet on the leading marks in 1901, but in 1902 was described as being practically dry at low water.

What is known as the New Channel, which has a straight northwest direction, passing northeastward of Elfin Flat, is dry at low water, and the bar is liable to deteriorate during the southwest monsoon, and with a southeast wind breaks right across; the last quarter flood is the best time for crossing.

As the rise at neaps is only 8 feet, and at springs from 11 to 13 feet, these are the greatest depths to be expected under favorable circumstances at high water.

Buoys.—Anchorage buoy, black, surmounted by a staff and cage, and with, on one side, an anchor, on the other letter B, painted white, is moored in a depth of 24 feet at low water spring tides $5\frac{1}{2}$ miles, 132° from Chandipur Flagstaff. By noting the depth at the anchorage buoy and comparing with the chart, the depth on the outer bar and in the river generally may be estimated.

Depths.—In 1914 the depth at the anchorage buoy was 24 feet, on Elfin Bar $1\frac{1}{2}$ feet, and on New Channel and Jimkhana Bars 2 feet.

A tide gauge is placed 1,100 yards inside the entrance of Burhabalang River, and near the south bank; about 200 yards westward of it is the landing pier, from which a road leads to Balasore Town.

Directions.—The beacons (with the exception of the spar beacon with basket on east entrance point) and buoys having been removed, the following directions must be used with caution.

Entering by the southern channel, bring Chandipur Flagstaff to bear 294° and steer for it, and when the spar beacon, surmounted by a basket, situated on the eastern entrance point to the river, bears 4° , alter course for it, which should lead to the entrance of the river.

No directions can be given for the New Channel.

Great caution must be used in taking the bar, as the channel is always liable to shift, and when crossing the bar, if the flood stream is running, a vessel must guard against being set northward.

The channel in the first reach of the river, which has a westerly direction, is near the northern bank until abreast Chota Ghira Point, where the river takes a very sharp turn to the southward, and the channel is near the east bank.

This reach, $1\frac{1}{2}$ miles in length, gradually curving round to the southwestward, has depths of from 7 to 9 feet at low water, increasing to 15 and 21 feet in its southern part, and the river now turns westward, and, rounding a point with deep water in the bend, turns nearly parallel, but in an opposite direction, to that before; the channel is on the south side in the bend, and on the eastern side in the next reach, till approaching Ghenti Point, where mid-channel should be kept; the depths here are from 9 to 26 feet.

The river from Ghenti Point winds westward, and 1,400 yards westward of Ghenti Point it is obstructed by Dinga Flat and Bar; when passing the former the north bank of the river must be closely followed, and Whoarguddi, the next reach, must be opened slightly before crossing the bar, on which there are depths of from 6 to 7 feet at low water. Small bamboo marks are placed for navigating this part of the river. Dinga Bar passed, the channel is on the south bank, and is deep until Whoarguddi is approached, where there are depths of 10 to 11 feet.

Jungle Point is the end of Whoarguddi Reach, and the river here takes a sharp trend to the eastward for $1\frac{1}{2}$ miles, with depths of from 9 to 18 feet to Chargutia Point, after rounding which the river turns westward for $1\frac{1}{2}$ miles to Bubur Point. The depth of this part of the river is from 3 to 10 feet at low water, the channel passing south of a detached sand bank, and then crossing to the north bank; again crossing to the south shore, as Bubur Point is approached.

From Bubur Point the river turns abruptly to the northward for 1 mile, and a sand bank, 800 yards long and 150 yards broad, blocks up the greater part of it; the navigable channel, which is on the western side, has depths of 3 feet. This part of the river is known as Bubur Bar. The river then winds round Nudiafa Point, and trends south-southwestward for 1 mile to Pukarabhar, then westward

for 1,400 yards to Jimkhana, and again southwestward for 1,100 yards to Muhammad Pau, rounding which Balasore Port is reached.

Jimkhana Bar, of sand, with a depth of 2 feet over it at low water, spring tides, is midway between Pukarabhar and Jimkhana.

About 400 yards northeastward of Muhammad Pau the channel of the river crosses to the west bank, on which side it continues to the customhouse at Balasore, a distance of 600 yards. Depths here vary between 10 and 22 feet at low water, spring tides.

Balasore Port, about $\frac{3}{4}$ mile in length, fronts Balasore Town. Northeastward of the customhouse at Balasore there is a depth of 10 feet at low water, but the river is only 100 yards wide, and a vessel must be moored head and stern.

Tides.—It is high water, full and change, at Burhabalang River entrance at about 10h. 0m.; springs rise 11 to 13 feet; neaps, 8 feet. At Balasore Town it is high water, full and change, at about 11h. 0m.; springs rise 10 feet; neaps, $6\frac{1}{2}$ feet.

Tidal streams.—In Balasore Road the tidal stream sets southwestward during the falling tide, and northeastward during the rising tide, the rate of each stream being about 2 knots an hour at springs.

In the river the ebb or outgoing stream lasts 8 or 9 hours, and runs as much as 4 knots an hour; the flood or ingoing stream is feeble, averaging about $\frac{1}{2}$ knot.

Balasore Town, the first place in Bengal occupied by the British, owes its importance to the safety of its roadstead, and, although it includes an extensive bazaar, is little more than a collection of hamlets covering an area of 5 square miles.

Besides the usual public offices are a district jail, general hospital, and charitable dispensary, and the railway bridge over the Burhabalang is an imposing structure; in 1901 the population was 20,880.

Farasdanga, a small area on the south side of the river below Balasore, is a French possession.

Communication.—Steamers of the Indian General Steam Navigation Co. call weekly, and moor head and stern off the customhouse. Balasore has also railway and telegraphic communication.

Supplies.—Provisions for vessels at Balasore Road can be procured by arrangement, either with the owners or cargo boats, or with the masters of the small steamers which ply to Calcutta. Fresh water is obtainable, but it is not good; the river water off Balasore Town at half ebb is fit for drinking.

Trade.—The principal exports are rice and stoneware, quarried chiefly in the Nilgiri Hills; and imports, cotton twist, European cotton piece goods, kerosene oil, and salt.

Large vessels load in the roads during the northeast monsoon.

Storm signals are shown at Balasore.

Cyclonic storms.—Balasore roadstead is in the track of cyclonic storms, and many disasters have been caused by them. Native craft approach the coast as near as high water will permit in threatening weather, and should a storm come on it is said they have little to fear. A vessel in doubt as regards weathering a storm might run into the western part of Balasore Road, near Kalikoti, where the bottom is soft mud, and shoals gradually.

Coast.—**Panchpara Nud** is a river situated $4\frac{1}{2}$ miles northeastward of Burhabalang River, and near its mouth are sand hills of mottled gray and yellow color; it bifurcates just within its entrance, and Chanuya Village lies about 5 miles up the western, and Sartha about 8 miles up the eastern, branch.

The bar has only a depth of about 1 foot on it at low tides, but within the river is deeper, and native vessels of 100 tons enter and ascend as far as Mahadani, 9 miles inland. The villages export rice and paddy.

From Panchpara Nud the coast, with several sand hills on it, trends $12\frac{1}{2}$ miles in an east-northeast direction to Subarnarekha River mouth, off which, at a distance of about 2 miles from it, is Pippli Sand, which dries.

Subarnarekha Port is almost choked by sand banks; on the western side of the river entrance stand a pagoda and tope of trees (not charted). On the left bank, about 20 miles from the sea, is Jaleswar (Jellasure), a village on the Calcutta high road. The port is principally visited by fishing boats, which in fair weather sail in numbers together as far as Puri.

Channel.—The channel, nearly dry at low water, is on the southwestern side of Pippli Sand, and within the river is said to be fairly deep, and navigable for country craft for about 16 miles, to which distance it is tidal and studded with islands. During the rains rice boats of about 2 tons capacity penetrate far up the Subarnarekha, which has a tortuous course of 296 miles.

Anchorage.—There is anchorage off Subarnarekha River mouth in depths of from $4\frac{1}{2}$ to 5 fathoms, over muddy bottom, with the pagoda bearing 326° and 8 miles from the shore.

Communication.—Jaleswar is a station on the Bengal-Nagpur Railway.

Coast.—From the Subarnarekha River the coast trends east-northeastward for about 10 miles to Birkul bungalows and is generally sandy; between is Quoin Sandhill. About 3 miles eastward of Birkul bungalows is the mouth of Digwah Mohan, shallow stream, and 4 miles farther that of Munder Mohan, which is similar.

Several creeks, including Sola Creek, then occur, and about 16 miles from Munder Mohan is Rasulpur River mouth; all this coast is low and without any distinguishable marks. The small vessels

that frequent Rasulpur River in their passage from the westward use a narrow channel close inshore, which has depths of from 3 to 6 feet but requires local knowledge.

Midnapore District, beginning at Birkul bungalows, extends for about 50 miles along the western bank of the Hugli River.

Geonkhali (Cowcolli) Light.—A fixed white light is exhibited, at an elevation of 75 feet above high water, from a brick tower, 80 feet in height, painted white, on the western side of Hugli River entrance, and about 2 miles from Khijiri semaphores; it is visible 15 miles.

The Pilots Ridge, a bank extending off the coast between False and Palmyras Points, affords an excellent guide in approaching Hugli River, as the bottom, in depths of less than 20 to 23 fathoms, is shelly sand and gravel of a reddish color, while in deeper water to the eastward or seaward it is sand and mud with shining specks, or olive-colored mud with broken shells. The eastern edge of the ridge is rather steep, the soundings seaward of it being from 28 to 30 fathoms.

The 20-fathom contour line trends northeast and from about 22 miles eastward of False Point Lighthouse passes 25 miles eastward of Palmyras Shoals.

Bank.—A bank of 19 fathoms of water, fine yellow sand, was reported by the steamship *Sildra* in 1914, in latitude $20^{\circ} 15'$ north, longitude $88^{\circ} 3'$ east.

Hugli River Approach—Lightvessels.—In Hugli River approaches light vessels exhibit a white light from the forestay at 6 feet above the rail, for the purpose of showing in which direction the vessel is riding when at their stations. When a light vessel is driven from the position assigned to one useless as a guide to shipping, the usual lights are not shown, but a fixed red light is exhibited from each end of the vessel, and a red flare burnt every quarter of an hour; by day the balls or other distinguishing masthead marks are struck, and the name covered over.

If from any cause a lightvessel in position is unable to exhibit all the usual lights, the riding light is shown and any of the usual lights that can be exhibited. Explosive rockets fired from a lightvessel indicate need of assistance from shore.

NOTE.—Apparent time is kept on board the lightvessels.

Pilots Ridge Lightvessel is painted red, with "Pilots Ridge" in white letters on the sides, and has one mast, with a black ball and a half ball, flat side up, over it at the masthead; the vessel is moored in 26 fathoms.

The lightvessel exhibits, at an elevation of 44 feet above the level of the sea, a flashing white light, visible 12 miles. A blue light is burned every hour between sunset and sunrise from March 15 to October 31.

Fogsignal.—A fog bell is sounded at intervals. (For details see Light List.)

Buoy.—The station buoy, conical, painted white, with "P. R." in the center of a black oval painted on the side and surmounted by a white open basket, is moored in 24 fathoms water 1 mile north of Pilots Ridge Lightvessel.

Tides.—It is high water, full and change, at Pilots Ridge at about 9 h. 50 m.; springs rise 9 feet, neaps 7 feet above lowest low water at extraordinary springs; neaps range 5 feet 9 inches (computed between March and September, approximate only).

Tidal streams.—From the end of June to the end of November there is little or no flood or westerly stream off False and Palmyras Points except at springs, but there is often a strong outset, caused by freshets from the rivers.

Seaward of the Sundarbans there are strong rotatory streams; the flood begins running westward, at the end of the first quarter its direction is west-northwestward, at half flood it runs about north, and during the last quarter east-northeastward. At the commencement of the ebb stream it sets east, at half ebb it runs southward, and during its last quarter west-southwestward, thus making a complete rotation.

Eastern Channel Lightvessel, painted red, with "Eastern Channel" in white letters on the sides, has one mast with a black ball at the masthead, and is moored in $13\frac{1}{2}$ fathoms at the entrance of Eastern Channel. The lightvessel exhibits, at an elevation of 44 feet above the water, a flashing white-light visible 12 miles.

From March 15 to October 31 a blue light is burned every half hour between sunset and sunrise, and from November 1 to March 14 a blue light is burned every hour between sunset and sunrise.

Fog signal.—During thick or foggy weather a fog bell is sounded. (For details see Light List.)

Buoy.—The station buoy, conical and painted white, is moored about 1 mile northward of Eastern Channel Lightvessel.

Tides.—It is high water, full and change at Eastern Channel Lightvessel at 8 h. 43 m.; springs rise $10\frac{1}{4}$ feet above lowest low water at extraordinary spring tides; neaps rise 8 feet; neaps range 4 feet 6 inches.

Tidal streams.—In Eastern Channel the tidal streams set as follows when uninfluenced by the wind:

	Flood.	Ebb.
First quarter.....	Northwest by west.....	Southeast by east.
Second quarter.....	North-northwest.....	South-southeast.
Third quarter.....	North-northeast.....	South by west.
Last quarter.....	East-northeast.....	Southwest by west-southwest.

The streams generally run in the directions of the channels, at rates of from 2 to 3 knots at springs, and 1 knot to $1\frac{1}{2}$ knots at neaps.

South Channel Buoy, with "S. C." painted on it and surmounted by a basket, is moored in a depth of about 10 fathoms, 12 miles 29° from Pilots Ridge Lightvessel, and 14 miles west-northwestward of Eastern Channel Lightvessel.

Pilot vessel—Cruising station.—A steam pilot vessel, painted white, with three masts and a yellow funnel, cruises off the entrance to the River Hugli. The pilot vessel communicates by radio with the lighthouse on Sagar Island.

During the southwest monsoon the vessel endeavors to cruise about 8 miles south to southwest of the Eastern Channel Lightvessel, and in very strong winds and a heavy sea about 10 miles.

During the northeast monsoon she cruises or anchors from 2 to 3 miles south by west to southwest of the same lightvessel.

If a pilot is not taken at the cruising station, one can not be obtained inside the river.

Pilotage—Pilot vessel—Light.—During the southwest monsoon period, from March 15 to October 31, the pilot vessel on station at the Sandheads will exhibit every half hour between sunset and sunrise a searchlight beam at an elevation of 30° .

The light will be revolved from east to west through south and back again, the total period of exhibition being one minute.

The pilot vessel shows the ordinary signals of a steam pilot vessel on her station (see Chapter I), and in addition, by day, flies a large blue flag at the main.

On an inward-bound vessel arriving at the Sandheads and not finding a vessel showing the above signals it will be understood that there are no pilots on the station, and a careful lookout must be kept for any signals that may be made, which will generally be by the pilot vessel.

Radio station.—The pilot vessel at the Sandheads is in direct communication with Calcutta by radio.

Approach—Directions.—Vessels arriving at Sandheads and requiring a pilot should, as soon as possible, signal their names and gross tonnage to the pilot vessel.

Vessels wishing to make any sound signals should do so in accordance with Article 28 of the Rule of the Road.

Sailing vessels should indicate their net tonnage.

Sailing vessels should not run for the station at night or in threatening weather, but under such circumstances put the vessel under easy sail while in deep water and keep the sea. The lead should be used frequently.

Steamers finding the steam pilot vessel at the station should close to a distance of about 300 yards under that vessel's stern, heading

in a similar direction and in such a manner as to make a lee for the pilot boat.

Sailing vessels arriving at the cruising ground known as Sandheads, and finding the pilot vessel at anchor must use the utmost caution in closing her on account of the strong tidal streams. When easterly winds prevail there is a strong set to the westward; it is then specially incumbent on strangers to be guided by the advice given from the pilot vessel.

A sailing vessel arriving at night should not heave-to to windward of the pilot vessel if intending to take a pilot before daylight, but close as soon as possible, approaching round the pilot vessel's stern, whether at anchor or under way.

In August, September, and October, when sailing vessels are signaled to keep to windward from there being no pilots or other causes, they should be most careful to keep the Eastern Lightvessel in sight, using a kedge anchor if the wind falls light, to prevent drifting off the station.

Signals from the pilot vessels to prepare for bad weather should not be ignored.

The tidal stream should be studied; with the first of the flood setting to the westward, a vessel should stand to the eastward, and the first of the ebb setting eastward, stand westward and northward.

Strangers anchoring below or at any distance off the lightvessel should endeavor to near the pilot vessel and not remain at anchor; a kedge anchor is useful.

The practice in a sailing vessel of rounding the pilot vessel close-to, in a seaway, is dangerous, both to the pilot vessel and to the boat alongside, as, on being brought to the wind the vessel may make a rapid stern board on to the pilot vessel, rendering it difficult for the latter to get clear, and in the case of the boat it may be liable to be swamped.

Lloyd's agents at Calcutta have facilities for delivering orders at the Sandheads.

Caution.—Should it be necessary when approaching Hugli River (the Sandheads) in heavy weather to anchor from any cause, a berth should, if possible, be taken up outside the line joining Eastern Channel and Matla Lightvessels in a depth of not less than 15 fathoms, over mud bottom, and the pilot vessels should not be closed until the weather moderates.

Less strain will be brought on a vessel's cable, and riding will be easier, if anchored in depths of from 15 to 20 fathoms, than in less water, especially in an estuary; the cable is never quite taut in the greater depths, and therefore is not so liable to part, and the sea has less force than when in shoaler water.

Directions—Sailing vessels approaching Hugli River.—In the southwest monsoon it is best to make the Orissa Coast about Pundi, or between it and Ganjam, where it is high, for in the latter part of March and early in April the weather is generally hazy, obscuring the land until very near; it is inadvisable to get northward of Puri before the position is ascertained.

The bank of soundings affords a valuable guide in approaching this coast, the 100-fathoms contour line being about 23 miles south-eastward of Pundi and Ganjam, and about 15 miles off Puri.

At night make either Kalingapatam, Gopalpur, or Puri Lights, using the lead continually in closing the land, and observing that the 20-fathom line is only 3 miles off Ganjam and 12 miles southeastward of Puri. When the position is ascertained, steer along the coast in depths of 18 or 20 fathoms at night or with unsettled weather; with daylight and clear weather, sight Jagganath and Black Pagodas in passing.

By night the depth should not be shoaled to less than 15 fathoms, as, the coast being low, it can not be seen unless close-to, and in hazy weather the noise of the surf would possibly be the first indication of being near it.

When about 10 miles past Black Pagoda steer for Pilots Ridge Lightvessel, paying particular attention to the lead when passing False Point, as the depths decrease gradually toward the bank surrounding it; but by night a vessel should not be in less depth than 14 or 15 fathoms, or even that of 20 fathoms if the wind is southeasterly; the tidal stream of the flood inclines toward the land, and that of the ebb away from it.

Having made Pilots Ridge Lightvessel, Eastern Channel Lightvessel may be steered for, and low water is the most convenient time for a vessel of deep draft to arrive at the latter, as the difference between the time of high water at Eastern Channel Lightvessel and at Calcutta enables such a vessel to arrive at the latter place in one tide.

Toward the close of the southwest monsoon, or in September, as the wind often hangs to the eastward and the current sets strong to the southwestward, if the position can be ascertained do not make the land so far to the southward.

In the northeast monsoon, if on the east side of the Bay of Bengal, steer direct for Eastern Channel Lightvessel; or when near the head of the bay, work up, making short tacks southward of that lightvessel.

Special quarantine regulations.—A vessel arriving at the Sandheads from an infected port, or having plague on board, or a vessel on board which one or more cases of plague have taken place within 12 days of the date of arrival, shall hoist and keep flying a yellow

flag and the signal indicating the port left, until permitted, in writing, by the health officer to haul them down.

During this period no communication shall be held with the shore, or with any other boat or vessel, with the exception of the boat supplying the pilot, his leadsman, servant, and baggage.

In the case of a vessel with any case of sickness on board which the pilot has reason to believe to be plague he shall telegraph to the health officer from Sagar and not proceed beyond Diamond Harbor without permission of the health officer. If the pilot has no reason to believe that there is any one suffering from plague on board he shall bring the vessel up the river to Matia Buruj, and anchor her there until visited by the health officer.

Vessels with cases of smallpox, cholera, measles, or other epidemic diseases common in India, or of diphtheria, or scarlatina on board, or, if two or more deaths from suspicious causes have occurred during the voyage, are to report the cases to the pilot immediately he boards the vessel, when he will give instructions as to the signals to be hoisted.

The sanitary station is at Diamond Harbor.

Hugli River—Lloyd's signal stations.—Signal stations are established at the Sandheads, Mud Point, Diamond Harbor, Hugli Point, Achipur, and Budge Budge.

Winds and weather.—The wind and weather prevalent at the Sandheads is given in the following table:

Month.	Wind.	Force.	Weather.	Remarks.
September, after breaking up of south west monsoon.	Easterly.....	Light and variable.	Showers of rain...	Westerly current depending on force and duration of easterly winds. Weather generally clear.
October.....	Easterly and calms.	Variable.....	Stormy, sultry at times.	Westerly and southwesterly current; generally a gale or cyclonic storm.
November, December, January.	Northerly in morning and evening.	Fresh in morning and evening, calm midday.	Fine weather with cool mornings and evenings.	Cessation of the strong tides of the Hugli; fogs in January in morning.
February.....	Variable, southerly at night; northwesterly sometimes.	Light.....	Warm toward end of month.	Thick fogs in morning; floods strong in Hugli toward end of month.
March, April, May.	Variable, until end of March; westerly and southwesterly in April and May.	Light at first, sometimes strong at end.	Northwesters, with rain, thunder, and lightning, frequent. Hazy.	Flood tide occasionally accompanied by bore; sometimes a gale or cyclonic storm in April or May.
June.....	Southwest.....	Strong at first...	Northwesters decreasing in force; heavy thunderstorms.	In June the "chota bursat" or small rain generally lasts a fortnight.
July.....	South west; westerly.	Strong; gales frequent.	Squally, heavy rains.	Freshets in the river; much swell in eastern channel.
August.....	Southwest and westerly; westward during day, hauling to southward toward evening.	Lighter.....	Squally, heavy rains; generally clear.	Strong westerly current at Sandheads.

Hugli River, the western, and for commercial purposes the most important, channel by which the Ganges enters the Bay of Bengal, is formed by the confluence of the Bhagirathi, Jalangi, and Matabhanga, the first deltaic offshoots from the Ganges, and known as the Nadia Rivers. The Hugli commences at the confluence of the Bhagirathi and the Jalangi opposite Nadia, about 79 miles above Calcutta; the Matabhanga joins the Hugli about 40 miles lower down.

The Hugli may be divided into two portions, namely, the river proper from Nadia to Kantabaria, and the estuary from Kantabaria to the mouth beyond Sagar Island. The navigable channel in the river is subject to annual variations, caused by the difference in direction of the scour of the freshets and flood stream respectively during the rainy and dry seasons, while the channel through the estuary is subject from time to time to changes across the whole of its width, such as occur in all wide, sandy, tidal estuaries in their natural condition.

In some parts of the river the changes in depths and in the directions of the channels are very rapid, and it would serve no useful purpose to attempt any description of the channels, bars, or depths, which, although correct when writing, might afterwards be altogether changed in the shortest possible time.

On the left bank the Hugli is connected by tidal channels with the various distributaries by which the Ganges enters the sea; some of these forming waterways for boat and steamer traffic from Calcutta through the Sundarbans to Eastern Bengal and Assam. For practical purposes the sea may be said to be about 83 miles from Calcutta, but the Eastern Channel Lightvessel lies about 122 miles from Calcutta. At the entrance the river is about 11 miles in width, between the coast near Bankiput and the southwest end of Sagar Island.

Depths.—To Sagar Roads, the least depth to be passed over from the bay, by Eastern Channel, is about 14 feet at lowest water, and about 26 feet at high water neaps, situated on Middleton Bar in Gaspar Channel, and the bar in Moyapur Reach had apparently depths of from 13 to 14 feet in 1909.

The Hugli, to Calcutta, can be navigated by vessels of 28 feet draft at high-water springs, and 24 feet draft at high-water neaps, from June to October, when the river is high; and by vessels of 26 and 22 feet draft at those times of tide, from October to June, when the river is low with normal conditions of bar.

The plan of the river can not be depended on, and the positions of lightvessels and buoys are shifted as necessary.

Buoys.—Proceeding up the Hugli starboard hand buoys are red, surmounted by a black staff and triangle; port-hand buoys are black, surmounted by a black staff and cylinder. The buoyage is in accordance with the uniform system of India.

Hugli River tides and tidal streams.—The tide in the Bay of Bengal in front of the mouths of the Ganges rises in different parts from $9\frac{1}{2}$ to 11 feet at the highest ordinary springs, attaining its greatest range of 11 feet at the Eastern Channel Entrance, and the range of neaps at the same point is $4\frac{1}{2}$ feet.

The tidal range gradually increases in converging to the Hugli Estuary and ascending the narrow channel. At Dublat, near the southeastern corner of Sagar Island, the mean range of greatest ordinary springs is 14 feet $2\frac{1}{2}$ inches; and the highest spring tides in each month throughout the year have an average range of 16 feet and the lowest neap tides 3 feet 9 inches.

At Diamond Harbor the mean range of greatest ordinary springs is 15 feet $9\frac{1}{2}$ inches, the maximum monthly range averages 17 feet 8 inches, and the minimum 5 feet 9 inches; while at Kidderpur the mean range of greatest ordinary springs is 11 feet $8\frac{1}{2}$ inches, and the range of the maxima and minima tides in each month averages 12 feet $9\frac{1}{2}$ inches and 5 feet respectively.

The tidal influence at high springs during the dry season extends about 5 miles above Nadia, or 181 miles from Hugli mouth. The highest tides are at night from November to February and by day from March to October.

The strong southerly winds, which prevail from March to September, drive the water into the river and raise its mean level in August and September, when the river is highest, 4 feet higher than in February and March, when the river is lowest, the northerly winds, which prevail from November to February, driving the water out of the river.

The large fresh-water discharge of the Hugli during the rainy season has very little influence on the tidal range in the estuary up to Hugli Point during spring tides, as the high and low water levels are both raised 1 foot to 2 feet above their levels of the dry season.

Above Hugli Point the influence of the freshets in checking the tidal influx, even at springs, becomes marked in the comparatively narrow channel, and in ascending the river the tidal rise becomes more and more a backing up of the fresh-water discharge, so that at Calcutta the out-going stream is only occasionally reversed at high springs during the height of the freshets.

The chief influences of the freshets on neap tides are manifested by a raising of the low-water level and a reduction in the tidal range as compared with the dry season. Low water of a low neap tide at Kidderpur is raised by the freshets to about the level of high water of a similar tide in the dry season.

The tidal wave takes 5h. 19m. travelling from Eastern Channel Lightvessel to Calcutta, its rate of progress being 44 miles an hour at that lightvessel, and 18 miles an hour at Calcutta.

The strength of the tidal streams varies in different parts of the river and at different times of the year; their rate is least during the northeast monsoon from November to February, when it is 3 to $3\frac{1}{2}$ knots an hour at springs, and $1\frac{1}{2}$ to 2 knots at neaps.

During the latter part of the dry season the southwest monsoon blowing in the direction of the flood stream increases its rate, so that it flows up the river at 4 to 6 knots an hour during springs from March to June.

The descent of the freshets from July to October causes the ebb stream to predominate, which reaches at that period a maximum rate during springs of 6 knots, whilst the flood is obliterated, except in the estuary.

Accordingly, as regards the tidal streams in the Hugli, there are three distinct periods in a year, lasting approximately four months each. During the cold season the flood stream has a slight preponderance over that of the ebb, owing to its shorter period of flow; during the second half of the dry season, the flood stream is considerably stronger than the ebb stream, being driven by the southwest monsoon; whereas during the rainy season the flood stream is overpowered by the descent of freshets which gives a great predominance to the ebb stream.

Bore.—The opposition to the influx of the tide along the upper part of the Hugli is manifested by the appearance of a bore at high spring tides. The shoals and sharp bends in the river appear to be the causes of the checking of the progress of the flood stream, which results in the creation of the bore.

The bores in the Hugli occur only on the highest, or at alternate spring tides; their appearance may, with certainty, be predicted by the season of the year and the parallax of the moon. During November, December, January, and February, on the periodical ebb of the sea, when the current sets down the bay, the tidal rise is small and the streams weak, and consequently there are no bores, except very rarely, only three instances being known in a period of 22 years.

During the northeast monsoon, if the wind which blows the water down the bay is unusually moderate, and the moon's parallax is high, there may be a high tide, and with it a bore, and this, in consequence of the rule of inequality of height with regard to the monsoon, will happen at night.

Bores occurring during the night being very rare, and consequently unexpected, are particularly dangerous, but they may be guarded against by always considering their occurrence possible during the northeast monsoon at night, upon a high parallax of the moon.

With the southwest monsoon the current sets up the bay, the sea level rises, the tidal rise is high and the tidal streams strong, and

whenever the parallax of the moon is high at springs there will be bores; when there are also strong southerly winds and freshets withheld the height of the bores is increased.

The first appearance of the bore is on the Diamond Sand, on the right bank of the river below Diamond Harbor, where the ascending wave runs on as a breaking roller, but it is not of much consequence until it enters the contracted reaches above Hugli Point, when, besides swamping boats, it affects vessels at anchor by causing them to run upstream, especially if there is a strong southerly breeze.

The bore reaches a maximum at Chinsura, about 26 miles above Kidderpur, and disappears above Naya Serai, 14 miles farther up the river. The bore on March 30, 1896, had a height of nearly 4 feet at Budge Budge and Calcutta, increasing to $5\frac{1}{2}$ feet at Chinsura, and falling to about 18 inches at Naya Serai.

Vessels at moorings surge and roll during the passage of the bore, as there is a sudden lift of 4 to 6 feet; and when bores are expected springs must be put on the flood moorings close down to the buoys, to relieve the jerk on the cables and bitts when the bore comes up.

It is fortunate that the bores at night, during the southwest monsoon, are not so high as those in the day.

Eastern or Sagar Channel, the main ship entrance, lies between Sagar Sand and Eastern Sea Reef, and extends from Eastern Channel Lightvessel to Lower Gaspar Lightvessel, or about 30 miles 349° . The deepest water is on its eastern side near the edge of Sagar Sand, where the bottom is generally a soft but sticky clay, in which the lead sinks deeply.

Intermediate Lightvessel, painted red, with "Intermediate" on the sides in white letters, and one mast, surmounted by a half ball, flat side uppermost, is moored 17 miles 359° from Eastern Channel Lightvessel in a depth of 7 fathoms.

The vessel exhibits, at an elevation of 44 feet above the level of the sea, a fixed white light, visible 12 miles.

Lower Gaspar Lightvessel, painted red with "Lower Gaspar" on her sides in white letters, has one mast, with a black cone at the masthead, and is moored in Gaspar Channel in 27 feet water, distant 14 miles north-northwestward from Intermediate Lightvessel.

The vessel exhibits, at an elevation of 44 feet above the level of the sea, a group flashing white light, visible 12 miles. (For details, see Light List.)

From sunset to sunrise a blue light is burnt at the half hour.

The vessel is slightly altered in position as the channel shifts.

Fogsignal.—A gun is fired and a bell sounded from this lightvessel at the hour and half hour.

Gaspar Channel, continuation of the main ship channel into the Hugli, extends northwestward from the upper part of Eastern

Channel to the lower part of Sagar Roads, or between Lower Gaspar and Middleton Lightvessels, a distance of $12\frac{3}{4}$ miles.

The present course through Gaspar Channel is slightly eastward of a line joining Gaspar Lightvessels, and then passes about a mile eastward of Middleton Lightvessel, the least water being about 14 feet on Middleton Bar, which joins Middleton Flat with Lower Long Sand, but the depth varies. The water shoals gradually from 28 feet abreast Lower Gaspar Lightvessel to Middleton Bar.

During the southwest monsoon there is usually too much sea in Gaspar Channel for a sailing vessel to work, so that unless the wind allows a vessel to head about 332° freely, with an allowance for the tidal stream, Gaspar Channel should not be taken.

Tides and tidal streams.—It is high water, full and change, at Lower Gaspar Lightvessel at 10h. 13m.; springs rise $15\frac{1}{2}$ feet, neaps rise 12 feet above lowest low water at extraordinary springs; neaps range $6\frac{1}{2}$ feet. Both flood and ebb streams set across the channel, especially in the last quarter of each tide.

Upper Gaspar Lightvessel, painted red, with "Upper Gaspar" in white letters on the sides, is moored in Gaspar Channel in 20 feet of water, 8 miles 180° from Sagar Lighthouse. The vessel exhibits, at an elevation of 30 feet above the level of the sea, a group flashing white light, visible 10 miles. (For details see Light List.)

Fogsignal.—The fogsignal is a bell sounded by the motion of the vessel.

Tides.—It is high water, full and change, at Upper Gaspar Lightvessel at 10h. 20m.; springs rise $15\frac{3}{4}$ feet, neaps $12\frac{1}{2}$ feet above lowest low water of extraordinary springs; neaps range $6\frac{1}{2}$ feet.

Middleton Lightvessel, painted red, with no masts, with "Middleton" in white on each side, is moored in about 18 feet water about $3\frac{3}{4}$ miles southward of Sagar Lighthouse.

The vessel exhibits, from a lantern tower 30 feet above the water, an occulting white light; it should be visible in clear weather from a distance of 10 miles, but being unwatched, it is unreliable.

A riding light, elevated 12 feet, is exhibited from the fore end of the vessel. (For details, see Light List.)

Fogsignal.—A fog bell is sounded by the vessel's motion.

Sagar Roads, northward of Middleton Lightvessel, and off the southwestern point of Sagar Island, affords safe anchorage in 5 to 8 fathoms in ordinary weather, but in heavy gales a considerable swell rolls in at high water.

Tides and tidal streams.—It is full water and change in Sagar Road at 10h. 4m.; springs rise $15\frac{3}{4}$ feet, neaps $12\frac{1}{2}$ feet above lowest low water at extraordinary springs. The tidal streams run fairly up and down Sagar Road.

Sagar Island, of low alluvial soil, and covered with impenetrable jungle, except some clearances on its northern side, is intersected with numerous creeks or khals, and infested with wild animals. On the eastern and northern sides of the island are some large villages where the land is cleared and cultivated, also Government salt works, and in 1901 the population of the island was 42,330. No attempt should be made by a shipwrecked crew to cross the island to the lighthouse, but follow the coast round and cross the creeks in preference.

Sagar Lighthouse, 80 feet in height, cylindrical, and painted red and white in bands, is situated about 1 mile northeastward of Middleton Point, the southwestern point of Sagar Island, and exhibits at an elevation of 84 feet above high water a flashing white light, visible 15 miles.

Signal station.—A signal station, belonging to the Indian telegraph department, is maintained at Sagar, near the lighthouse, and is connected with Calcutta by telegraph.

The following signal may be hoisted at Sagar Island during rough weather at the Sandheads: "T. J. P.: Pilot can not get off."

Storm signals are hoisted at the following flagstuffs: Near the lighthouse on Sagar Island, near the telegraph office at Mud Point, and near the telegraph office, Diamond Harbor; also in the port of Calcutta—at the flagstaff upon the port commissioners' office; on a flagstaff at Shalimar Point, Sibpur, and on a flagstaff at Budge-Budge Telegraph Office—on receipt of instructions telegraphed by the meteorological reporter to the Bengal Government. These signals are the same as those mentioned in Chapter I.

DANGER SIGNAL V.—By day: A cone, point downward, hoisted vertically over a diamond shape (formed by placing two cones base to base), indicates that a storm of slight or moderate severity will probably cross the coast to the east of Sagar Island and west of Chittagong. Vessels may proceed to sea if the height of the barometer, state of the sea, and weather are such as to lead masters and pilots to infer that there is no danger. The wind at the mouth of the Hugli will probably haul from northeast, through north, to northwest or west.

By night: The signal is two white lights hoisted vertically over a red light.

DANGER SIGNAL VI.—By day: A cone, point upward, hoisted vertically over a diamond shape, indicates that a storm of slight or moderate severity will probably cross the coast to the west of Sagar Island and north of False Point. The wind at the mouth of the Hugli will probably veer from northeast, through east, to southeast or south. As these easterly winds will raise a heavy swell and produce a strong westerly set in the channel at the Sandheads, it is advisable that none but fast steamers in light trim should put to sea,

and those only if the weather appearances and state of the sea are not too unfavorable.

By night: The signal is two white lights hoisted vertically under a red light.

DANGER SIGNAL VII.—By day: Two cones, points together, hoisted vertically over a diamond shape, indicate the approach toward Sagar Roads of a storm of slight or moderate intensity. It is advisable that no vessel, except fast vessels in light trim, should put to sea until the wind direction and force, the state of weather and sea, and the rise of the barometer indicate that the storm has either broken up or passed inland. It should be remembered that cyclonic storms of small extent in the Bay of Bengal sometimes blow with hurrican force and raise a high sea near their centers.

By night: The signal is a red light between two white lights hoisted vertically.

GREAT DANGER SIGNAL VIII.—By day: A cone, point downward, hoisted vertically over a cylinder placed vertically, indicates that a storm of great intensity will cross the coast to the east of Sagar Island and west of Chittagong. No sailing vessels, nor deep-laden, nor slow-steaming vessels should go to sea. The wind at the mouth of the Hugli will probably shift from northeast to north, north-west, etc.

By night.—A white light over two red lights hoisted vertically.

GREAT DANGER SIGNAL IX.—By day: A cone, point upward, hoisted vertically over a cylinder placed vertically, indicates that a storm of great intensity will cross the coast to the west of Sagar Island and north of False Point. No vessel should go to sea, and masters and pilots of vessels outward-bound should be guided by the appearance of the weather and height of the barometer in deciding whether it is advisable to proceed below Diamond Harbor or Mud Point. The wind at the mouth of the Hugli will probably veer from north-east, through east, to southeast or south.

By night.—Two red lights hoisted vertically over a white light.

GREAT DANGER SIGNAL X.—By day: Two cones, points together, hoisted vertically over a cylinder placed vertically, indicate the approach of a storm of great intensity toward the mouth of the Hugli and Calcutta. No vessels should go to sea from Sagar Island, or proceed down from Diamond Harbor, and all vessels should be properly secured.

The masters of vessels in the port should take the special precautions for safety laid down in the port rules. There will probably be a storm wave, but its height and destructive effect depend quite as much on the state and character of the tide when the cyclonic center reaches the coast, as upon the depression of the center, or the intensity and extent of the storm.

By night.—A white light between two red lights hoisted vertically.

A severe cyclonic storm is frequently accompanied by a storm wave, which is not often the case with a small cyclonic storm.

Kalpi Anchorage—Compass adjustment marks.—A mast, the lower part of which is painted in red and white bands, surmounted by an oval-shaped cage, erected on the right bank of the river at Kalpi Road 30 miles above Sagar Road, in line with Jigerkolli Obelisk, bears $280^{\circ} 19'$, and is intended as a mark to enable vessels to ascertain the error of the compass.

There is good anchorage with this mark on, and Kantabaria Obelisk bearing 5° .

Lights.—A fixed white light is exhibited at an elevation of 12 feet above the river, from a position near Kalpi Beacon and should be visible 5 miles.

A fixed red light is shown at an elevation of 16 feet above the river from an obelisk or mast on Kantabaria Point, about 3 miles northward of Kalpi, and should be visible 5 miles.

Diamond Harbor, in Hugli River above a creek of the same name on its left bank and about 42 miles above Sagar Road, affords anchorage for large vessels, but is seldom resorted to except by foreign vessels not wishing to ascend to Calcutta.

This is the third reporting station for passing vessels who are boarded by a dak boat generally furnished with the latest weather chart, railway time-table, etc.; the boat for outward-bound vessels flies a blue flag and that for inward-bound vessels a red flag.

Lights.—A fixed red light is exhibited, at an elevation of 14 feet above the river, from a yardarm at the telegraph office, and a similar light is shown from near the customhouse; these lights should be visible 2 miles. A similar light is also shown at Fishermans Point, on the west bank of the river.

Communication.—Diamond Harbor is connected with Calcutta by railway and road, and there is a telegraph station and customhouse.

Tides.—It is high water, full and change, in Diamond Harbor at 11h. 55m.; springs rise $16\frac{1}{2}$ feet and neaps $12\frac{1}{4}$ feet above lowest low water at extraordinary springs; neaps range $7\frac{1}{4}$ feet. These tides are computed for the dry season only; during the freshets spring tides probably rise 3 to 4 feet higher.

Calcutta, the capital of the Indian Empire and the official residence of the viceroy and governor general, is situated on the left bank of the Hugli, about 86 miles from its mouth, originally the site of the three riverside hamlets of Sutanuti, Kalikata, and Gobindpur; its stretches northward for 6 miles along the river bank, is only from 18 to 21 feet above mean sea level, and covers an area of 20,547 acres.

Port.—The port of Calcutta extends for nearly 16 miles along the Hugli, or from Budge-Budge khal or creek on the south to Cossipur on the north, the limits being marked by pillars, and moorings are laid down for about 43 large vessels, which can also be accommodated in the wet docks or at the jetties, which are suitable for vessels of 28 feet draft, but by using pontoons a very large number of berths for that draft could be obtained; both docks and jetties are furnished with hydraulic cranes and are connected with the several railways.

There is sufficient water for vessels of any draft that can enter the river at the moorings, where they are required to moor head and stern with two bower and two stern cables shackled to the permanent moorings laid down parallel to the bank.

The port rules are furnished to vessels on arrival.

The navigable channels of the Hugli, leading to the port of Calcutta from a line drawn east and west from Eastern Channel Light-vessel, are subject to the jurisdiction of the commissioners for the port of Calcutta.

Calcutta Reach extends from Kidderpur Docks to Hugli Bridge on the east, and from Shalimar Point to Howrah Docks on the west bank of the river, trending from about 197° at the bridge to 247° at Kidderpur, a distance of about $2\frac{1}{2}$ miles. The channel lies close along the Calcutta Bank and contracts in width from 500 yards at the bridge to 250 yards abreast Fort Point; it then widens to 600 yards abreast Kidderpur. There are from 36 to 51 feet in the channel for about 1,400 yards below the bridge, and then 23 to 60 feet to Garden Reach.

Navigation.—Vessels going against the tidal stream should ease down or stop if likely to meet other vessels at difficult parts of the river, or on bars where the deep-water channels are narrow. The usual rule of the road is adhered to in the river and estuary. A prolonged blast of the steam whistle, quickly followed by three short blasts, is an optional signal that the vessel making the signal is obliged to stop and can not get out of the way.

Tugs.—Several tugs are available.

Tides.—It is high water, full and change, at Calcutta at 2h. 2m.; springs rise 17 feet, neaps rise 12 feet, above Kidderpur Old Dock sill, which is 7.986 feet below mean sea level, and has been accepted as equivalent to the level of mean low water ordinary springs; neaps range 7 feet. During the freshets mean springs rise 21 feet, and mean neaps 16 feet, above Kidderpur Old Dock sill, and between December and June, the dry months, the average rise at springs is 15 feet 2 inches, and at neaps 11 feet 4 inches, above the same datum.

The time of high water is that at which the tide reaches the greatest altitude and commences to fall, although the stream will continue to run up about an hour, and the time of low water is that

at which it reaches its greatest depression and commences to rise, although the stream will continue to run down a little more than an hour.

Tidal streams.—When regular, the flood stream runs 5 hours, the ebb stream 7 hours. During the northeast monsoon the rate of the streams is 3 to $3\frac{1}{2}$ knots at springs and $1\frac{1}{2}$ to 2 knots at neaps; between March and July the rate of the flood stream is 4 to 6 knots at springs; and during the freshets, July to October, the rate of the streams is sometimes 6 knots; anchors are then quickly buried by the silt, so that sometimes it is necessary to slip the cable and leave the anchor to be picked up by the port commissioner's hoy. The tidal streams set fair up and down the reach.

City.—In the center of the city stands Fort William, surrounded by an expanse of park, known as the Maidan, and northward of this are the shops and business houses of the Europeans, whose residential quarter bounds it on the east.

Among the public buildings may be mentioned the Government House; Belvedere, the residence of the lieutenant governor, and the high court; the town hall, the Indian Museum, the mint, and the general post office, while the churches are the Cathedral Church, St. John's, the old Catholic, and the Roman Catholic Cathedral.

The European suburbs of Ballygunge and Alipore, which latter contains the residence of the lieutenant general of Bengal, lie to the southward and southeastward, and the European quarter is surrounded on all sides by the native town, the lanes of which are narrow, tortuous, and badly lit, with overcrowded and insanitary dwellings, but three main roads traverse it from north to south and five or six from east to west.

Population.—In 1911 the population of the city, with the suburbs, was 1,222,313.

The United States is represented by a consul general and a vice consul.

Communication.—The British India Co. have weekly steamers to Rangoon, Penang, Singapore, Chittagong, Akyab, Kyaukpya, Sandoway, and Moulmein, and those of the Messageries Maritimes to Madras, Pondicherri, and Colombo, and coasting trade is carried on by vessels of the India General, Calcutta Steam and Rivers Steam Navigating companies.

Three great railways converge on Calcutta, the East Indian connecting it with Bombay, the United Provinces, and the Punjab; its terminus is on the west bank of the river at Howrah, but a branch, crossing the Hugli by a bridge at Naihati, 25 miles up the river, provides access to the docks at Kidderpur over the Eastern Bengal State Railway.

The Bengal-Nagpur Railway runs through Orissa to Madras, and westward through the central Provinces to Bombay; its terminus is also at Howrah, but a wagon ferry plies between Shalimar and the docks.

The Eastern Bengal State Railway, the terminus of which is at Sealdah, connects Calcutta with North and East Bengal and Assam, and with Diamond Harbor.

There are two light railways from Howrah to Amta and Sheakhala, and lines of electric tramways run in the principal parts of the city. Calcutta has telegraphic communication with all parts.

Hugli Bridge, crossing the river above Howrah Railway terminus, is a wooden structure about 1,530 feet long, floating on iron pontoons, and is opened for the passage of vessels three times a week, as advertised in the daily papers. There are also several ferries.

Coal and supplies.—Almost any quantity of coal can be obtained, as nearly 1,000,000 tons are raised from the mines annually, and about 1,000 tons could be put on board in 24 hours, vessels coaling either at Budge Budge in the stream or at the docks, where the coaling space is practically unlimited. About 100 tons of liquid fuel is kept in stock, and about 500 tons imported annually; it could be put on board as quickly as a vessel could take it.

Fresh provisions and stores are plentiful and cheap, and filtered water is supplied to shipping, either by boats or from hydrants, on making application to the superintendent of water supply for shipping at the police office.

Repairs.—Large repairs to machinery can be executed, and there are a number of cranes, one of which will lift 30 tons.

Docks.—The government has one dock and the port commissioners have two, and there are seven private docks, also four patent slips. For dimensions see Appendices I and II.

Hospital.—There is a hospital for seamen and a sailors' home at Calcutta. Ambulance cars with bearers are stationed at suitable places for the conveyance of seamen to hospital.

Time signals.—At Fort William semaphore tower, at an elevation of 128 feet above the river, a ball, hoisted close up at five minutes before the signal, is dropped daily at 1 h. 0m. 0s. p. m., Calcutta mean time, equivalent to 19h. 6m., 39.2 s., Greenwich mean time.

A ball, also hoisted up at five minutes before the signal, is simultaneously dropped at the port commissioners' office, about $1\frac{1}{4}$ miles higher up, and 116 feet above the river.

At Kidderpur Docks, at an elevation of 84 feet above the river, a ball is hoisted five minutes before the signal is dropped at the same time as the preceding.

A flag is hoisted on the semaphore tower at the port commissioners' office at 20 minutes before the signal.

Indian mean time is only kept by railway, postal, and telegraph services, otherwise mean time of place is that generally used.

Trade.—The chief exports are raw and manufactured jute, tea, opium, hides and skins, oilseeds, grain and pulses, indigo, lac, raw cotton, coal, raw silk, saltpeter, and oils; and imports, cotton goods, treasure, metals, oil, sugar, machinery, woolen goods, hardware, salt, liquors, apparel, drugs, etc.

Radio station.—A radio station, open to the general public at all times, is established at Calcutta. The call letters are V.W.C.

Weather signals are communicated to ships.

Climate.—The climate is hot and moist, the average mean temperature being 77.9° ; mean maximum 106.6° , in June, and mean minimum 45° , in December. The average temperature in the hot season is 85° , in the rains 83° , and in the cold season 72° . The average rainfall is 59 inches.

The Sundarbans are fully described in Chapter I.

The extreme length of the coast line of the Sundarbans is about 165 miles, the western and eastern portions lying high when compared with the low and swampy central part, toward which the ground gradually slopes.

In the western part, the water of the streams is usually salt, and the cultivated lands are surrounded by high embankments with scattered clusters of huts. In the central part there are no habitations, the water is fresh, and the embankments surrounding the fields are lower.

In the eastern part, the land is high, the soil is richer, and, as the river water in this part is almost fresh, embankments are not necessary; the inlying parts are to a great extent protected from the effects of cyclonic storm waves by the belt of thick jungle near the sea.

The chief place in the Sundarbans is Khulna, about 65 miles eastward of Calcutta, at the junction of Atharabanka and Bhairab Rivers, toward which boats can be tracked through the Calcutta Canals. Khulna has railway communication.

Houses of refuge for shipwrecked seamen and others have been erected on the Sundarbans in the following places:

No. 1, at Seyer Point, about 13 miles east-southeastward of Sagar Lighthouse, is painted red, and is on a grassy plain eastward of some high sand hills.

No. 2, on the eastern side of, and 3 miles within, Sattarmukhi River entrance, and 9 miles northeastward of house No. 1, is painted white, and situated in thick jungle 200 yards from high-water mark.

No. 3, on the western side of Balchari Island and eastern side of Jamira River entrance, is painted black, and lies 200 yards from high-water mark.

No. 4, on the southeast point of Dalhousie Island and 6 miles eastward of Matla River entrance, is painted white, and built on a sandy patch; when last reported on, a spar and bamboo with a white flag visible over the trees close to it.

Owing to these houses being continually looted, they are now supplied with water only, and are visited by a steamer after cyclones and heavy gales, so that, under such circumstances it would be advisable for shipwrecked persons having no boats to remain by the house until assistance arrives, or, if traveling, the party should keep together, as the jungle is infested with tigers.

Each house is supplied with a punt, with which it may be possible to communicate with vessels entering the river, and a rope placed amongst the stores is for the purpose of assisting to construct a raft for tracking purposes, the wood for which may sometimes be found thrown up in quantities.

When traveling, the branches of trees should be broken on the same side of the trees as the direction in which the party is proceeding, leaving the broken parts hanging, and this especially at turning points or the entrances of any creeks that may be passed, so that a search party may know the route to be followed.

Means of kindling a fire should, if possible, be taken, and the following will be found edible:

The hearts of young palm trees and the scurvy grass or samphire, both growing in great quantity; oysters, which may be obtained at low water only from an oyster bed on the opposite bank of the river to No. 4 refuge house; these latter are coarse flavored, but very nutritious, and may probably be found in other localities.

Water can be procured by digging down a few feet on the higher parts of the land near No. 1 refuge house, and shoots attached to the roofs of houses are for catching water, which is saved by a hose to be found amongst the stores; the tanks should be filled when rain occurs, and, if possible, before leaving the house.

Eastward of Sagar Island are a series of low, alluvial, jungle-grown islands, intersected by numerous creeks and rivers, and with sands extending many miles southward of them, for which the chart is the best guide.

Lacams Channel, leading to Baratola River or Channel Creek, which passes eastward of Sagar Island, is the entrance to the Húgli between Sagar and Sattarmukhi or Lighthouse Sands. Lacams Channel appears to have a fairway about 2 miles to $\frac{1}{2}$ mile in width into Baratola River, or Channel Creek, but the latter can not now be used by seagoing vessels, as very rapid changes have been going on of late years in this part of the Sundarbans.

Sattarmukhi Channel, the entrance to which is between Sattarmukhi and Balchari Sands, splits into two branches abreast Balchari

Island, the western being Sattarmukhi River and the eastern Jamira River, neither of which are visited by sea-going vessels.

Tides.—It is high water, full and change, in Sattarmukhi Channel 9h. 30m.; springs rise 12 feet. The tidal streams have a velocity of about 2 knots.

Matla Lightvessel, painted red, with "Matlah" in white letters on the sides, has one mast and a black half ball, flat side upwards, surmounted by a cone, point downwards, on the masthead; it is moored in 17 fathoms water off the entrance to Matla River, and exhibits at an elevation of 48 feet above water a group flashing white light, visible 12 miles.

Buoy.—The station buoy, painted red and white in vertical stripes and surmounted by a red open basket, is moored 1 mile northward of the lightvessel.

Matla River is the united Bidyadhari, Karatoya, and Atharabanka Streams, and flows southward through the Sundarbans into the Bay of Bengal. The mouth of the Matla, about 27 miles eastward of Sagar Island, is separated from Jamira River by Balchari Island and Flats. The Matla has several branches at its mouth, one of which extends to the salt-water lake near Calcutta, and is entered by two channels, the Western and the Eastern.

NOTE.—The shoals at the entrance of the river are liable to change, and the following information must be used with caution. There are no pilots for Matla River.

Port Canning, about 60 miles from the mouth of the Matla, and formerly a municipality, was started by an English company to supply an auxiliary harbor to Calcutta, but the attempt failed.

Communication.—A railway connects it with Calcutta, but it is chiefly used for a small traffic in timber and other produce from the Sundarbans.

Western (Wards) Channel.—Between Balchari Sand, to the westward, and Raimatla Sand, to the eastward, is the entrance to Western Channel, which is about $5\frac{1}{2}$ miles in width at its entrance, narrowing to about $1\frac{1}{2}$ miles at the northern end of Raimatla Sand; it is to be preferred to the Eastern Channel.

Depth.—Western Channel has a least depth of about 4 fathoms westward of the northern prong of Raimatla Sand.

Eastern (Raimatla) Channel, between Raimatla and Dalhousie Sands, is about $2\frac{1}{4}$ miles in width at its entrance, but contracted to about 1 mile by a shoal extending southward of Dalhousie Point, between the 5-fathom contour lines.

Depth.—The depth is about $5\frac{1}{2}$ fathoms at the entrance, with some spots of 5 fathoms in the channel of the river.

Anchorage.—The anchorage off Port Canning is in depths of from 4 to 8 fathoms.

Navigation.—The entrance to Matla River is not so difficult as that to the Hugli, and the chief difficulty to the navigation of the former consists in the fact that the soundings are so regular between Matla Lightvessel and Dalhousie Point that the lead gives no indication as to the position of a vessel as regards the edges of the sands either side, and these, both in the channels and in the river, are so steep as to render borrowing on them dangerous.

Raimatla Sand extends from its southern extreme in a north-northwest direction for nearly 17 miles with a width of from 3 to 4 miles; a narrow spit then projects about 6 miles further northward to about $2\frac{1}{2}$ miles southwestward of Dalhousie Point. A portion of the sand about 3 miles in length by 2 miles in width, about 12 miles from its southern extreme, dries in places at low water.

Dalhousie Point has clumps of trees on it, the westernmost appearing double and larger than the rest; this point and Halliday Island, to the westward of Dalhousie Island, may be seen from a distance of about 10 miles when at a height of about 24 feet. On nearing Dalhousie Point it shows a high white sandy beach, conspicuous when the sun is out.

Below Kattali, which is situated 12 miles northward of the north point of Dalhousie Island, the land is so low that at high water springs the water runs some distance inland, and from the sea to Edu Reach there is dense jungle, but that reach to Canning, a distance of about 8 miles, there are clearances with native villages.

Tides.—It is high water, full and change, at the following points near the entrance and in the river:

At Matla Lightvessel at 9h. 43m.; springs rise $9\frac{1}{4}$ feet, neaps rise $6\frac{3}{4}$ feet, neaps range $3\frac{1}{4}$ feet.

At Western Channel at 9h. 0m.; springs rise 10 feet.

At Halliday Island at 10h. 12m.; springs rise 10 feet, neaps rise $7\frac{1}{2}$ feet, neaps range 5 feet.

At Kattali, on the west side of the entrance to Bidda River, at 10h. 45m.; springs rise 14 feet, neaps rise 12 feet, neaps range 7 feet.

At Port Canning at 0h. 5m.; springs rise $17\frac{1}{2}$ feet, the tidal rise being above lowest low water at extraordinary springs.

Tidal streams.—The tidal streams below Dalhousie Sand appear to rotate, the flood stream setting west-northwestward at its commencement and working through north, round to east-northeast, and the ebb stream setting east-southeastward through south to west-southwest, at rates of 2 to 3 knots at springs and 1 knot to $1\frac{1}{2}$ knots at neaps.

In the channel the flood stream tends toward the eastern shore until abreast Dalhousie River at the north end of Dalhousie Island, when it crosses southward of Grappler Sand toward Peel Point, forming eddies; it then runs northward to Roger Point, where it

bifurcates, the greater portion going up Bidda River, and the rest around Roger Point into Kattali Bight, leaving slack water in the vicinity of Bidda River Point.

The rate of the flood stream varies in different parts of the river, but 5 knots an hour is the greatest recorded.

The ebb stream sets fairly down the river, but it forms considerable eddies off Roger Point; at the last of the ebb the stream sets from abreast the north end of Dalhousie Island across the river toward Halliday Island. The greatest recorded rate of the ebb is from 1 knot to $2\frac{1}{2}$ knots.

Canning Town is almost deserted and in a dilapidated condition; the brick buildings, exclusive of railway station, cutchery, and rice mills, being in ruins. In 1901 the population was 1,049.

Bangaduni River, about 5 miles eastward of Matla River, is small and about 3 miles in width at its entrance between Dalhousie and Bangaduni Sands. Bangaduni Island is on the eastern side of the entrance, and northward of it is a narrow channel in which the depths are from $2\frac{3}{4}$ to 8 fathoms.

Depths.—There is a depth of $5\frac{1}{2}$ fathoms in mid-channel of the entrance, shoaling to $3\frac{1}{4}$ fathoms about 5 miles inside, and with a bar on which there is a least depth of $\frac{1}{2}$ fathom connecting the northern part of Dalhousie Sand with the southwest point of Bangaduni Island.

Guasuba River, about 5 miles eastward of Bangaduni River, is of considerable size, but difficult to enter on account of the shoals at its mouth, which are probably subject to change.

Raimangal River, about 12 miles eastward of Guasuba River, receives, 6 miles from the sea, Hariabhanga Stream on its western and the Jamuna on its eastern side. This river is one of the most considerable openings on the coast, but it requires local knowledge for its navigation; the outer part is about $1\frac{1}{2}$ miles in width.

Depths.—Raimangal River has a depth of $3\frac{1}{2}$ fathoms at its entrance, and appears to have depths of from 4 to 7 fathoms to its bifurcation, and even deeper water inside that.

Malancha River entrance is about 7 miles eastward of Raimangal River, and is less than $\frac{1}{2}$ mile wide in places.

Depths.—The channel leading into it from the southward has depths of 3 to 4 fathoms, and is narrow, with deeper water within.

Bara Panga River, entered about 5 miles eastward of Malancha River, is divided from it by Putni Island, from which island flats, with 3 fathoms and less water over them, extend southward and southeastward for about 11 miles.

Depths.—There does not appear to be a depth of more than 2 fathoms at the entrance to this river.

Marjata (Kaga) River entrance is about 9 miles eastward of Putni Island, and appears to have extensive banks in it; two low islets, named Pavanga, are about 5 miles inside the entrance.

Depths.—There appears to be a depth of about $3\frac{1}{2}$ fathoms in the channel, which is intricate.

Bangara River entrance is about 13 miles eastward of that of the Marjata; the river is small and takes a southeasterly course near its mouth, which is separated from that of Marjata by two islands with a small river between them. All three rivers communicate with each other.

Argo Flat is the extensive shoal which extends off the mouths of Bangara and Haringhata Rivers, and stretches seaward for about 15 miles. The flat has general depths of from $1\frac{1}{2}$ to $2\frac{1}{2}$ fathoms over it, but shows dry sandbanks in places, and heavy breakers have been observed on it at a distance of about 10 miles southward of Tiger Point, on the western side of Haringhata River Entrance.

Swatch of No Ground, latitude $21^{\circ} 24'$ north, longitude $89^{\circ} 34'$ east, a remarkable depression in the coast bank of soundings, is from 6 to 12 miles in breadth; from the position given, which is its north end, it drops suddenly to 90 and 113 fathoms, whence it extends seaward in a south-southwest direction, and at a distance of about 46 miles there is a depth of 595 fathoms.

Haringhata (Baleswar) River, signifying deer ford, about 12 miles eastward of Bangara River Entrance, is a deep estuary about 7 miles broad at its mouth, which is the outlet of one of the principal distributaries of the Ganges, the river and its tributaries passing through a tract of fertile country.

Navigation.—The river is navigable by seagoing ships as high as Morrellganj, 33 miles from the entrance, and throughout its entire course by the largest native boats, and the navigation is said to be easier than that of any other river at the head of the Bay of Bengal, as the river is free from a bore, and also from mid-channel dangers.

A heavy sea prevails at the entrance during the southwest monsoon, and it should not be entered without local knowledge, failing which a pilot is always necessary.

Depth.—The bar which stretches across the mouth of the Haringhata has about $2\frac{1}{2}$ fathoms over it at low water.

Morrellganj was converted from impenetrable jungle into a prosperous rice-growing tract, and here the river, which is tidal, is about $\frac{1}{2}$ mile broad, with deep water from bank to bank, affording sheltered anchorage, with good holding ground; although its position on a navigable river, commanding a rich rice country, renders it a great center for local trade, it has never yet become a port for sea-going vessels. In 1901 the population was 972.

Communication.—Morrellganj is an important place of call for steamers of the Cachar-Sundarbans service.

Tides.—It is high water, full and change, at Haringhata River Entrance at 11h. 0m., springs rise $10\frac{1}{2}$ feet.

Tidal streams.—The rate of the tidal stream is reported to exceed 4 knots at springs.

Rabnabad Islands are situated on the eastern side of the entrance to the channel of the same name, and about 18 miles eastward of Haringhata River, the westernmost and largest island is nearly 14 miles in length and $2\frac{1}{4}$ miles in greatest breadth. Rabnabad Channel, westward of it, is narrow, with a depth in the northern part at low water of $2\frac{1}{4}$ fathoms. After turning round the northern point of Rabnabad Island, this channel connects with Ganges River through Kajul and Tetulia Rivers, which are little known.

Storm signals.—Special signals are used on the rivers of the Ganges delta, and are shown at Morrellganj, Barisal, Goalunda, Noakhali, and Narayanganj.

SIGNAL I.—WARNING.—By day: A black ball indicates: A storm may affect you shortly.

By night: A red light is hoisted.

SIGNAL II.—DANGER.—By day: A cone, point upward, indicates: A storm will soon strike you.

By night: Two red lights, hoisted vertically.

SIGNAL III.—GREAT DANGER.—By day: A cylinder, hoisted vertically, indicates: A violent storm will soon strike you.

By night: Three red lights, hoisted vertically.

Barisal Town, on the west bank of Barisal River (which is connected with the Ganges), is the headquarters of Backergunge District, and has wide, straight, and well-kept streets, the riverside road to Sagardi being bordered by fine avenues; it is intersected by numerous creeks, which are flushed twice daily at flood tide, thus adding greatly to the health of the town.

In addition to the usual public offices it has three churches belonging to the Anglican, Roman Catholic, and Baptist persuasions, a college, and free library; in 1901 the population was 18,978.

Communication.—The Barisal River is navigable by steamers all the year round, and daily steamers ply to Khulna and Narayanganj, establishing communication with Calcutta and Dacca, the journeys occupying 24 and 12 hours, respectively; there is also steamer communication with Patuakhali.

Tetulia River, which appears to afford the nearest route to Barisal from seaward, is from 2 to 3 miles in width, but has not been surveyed.

Meghna Flats extend several miles southeastward of Haringhata River Mouth, and southwestward of the Shahbazzpur Entrance to.

Meghna River, the position given being that of their southern extreme, and apparently they are not extending.

D'Apres Shoal, a sand bank which dries at low water, is situated about 60 miles northeastward of the south extreme of Meghna Flats, or about 24 miles southward of the south point of Hatia Island on the eastern side of the entrance to Shahbazpur River.

A shoal, on which a depth of 15 feet is reported, lies nearly 15 miles eastward of D'Apres Shoal, and the area to the northward of these shoals has not been surveyed.

Tides and tidal streams.—It is high water, full and change, off the south extreme of the Meghna Flats at 9 h. 30 m.; springs rise 10½ feet. In depths of 5 fathoms and less there is always a swell during the first half-hour of the flood stream.

Near D'Apres Shoal, it is high water, full and change, at 1 h. 30 m.; springs rise 9 to 10 feet; the rate of the tidal stream is about 4 knots.

Brahmaputra River, known to the Assamese as the Haraniya, has an estimated length of about 1,800 miles; the great bulk of its waters flow southwestward, and reach the sea by the broad estuary of the Meghna River. The actual course before reaching British territory has not been satisfactorily determined but the main stream of the river is formed by the confluence of the Dibang, Dihang, and Brahmaputra proper, in about latitude 27° 50' north, longitude 95° 50' east.

In agricultural and commercial utility the Brahmaputra ranks next after the Ganges and the Indus among the rivers of India, although no large towns are situated on its banks. It is navigable by river steamers as high up as Dibrugarh, about 800 miles from the sea, but the current is so strong in places that vessels are sometimes unable to make headway, and have to stop for days.

Sirajganj, in the Bengal district of Pabna, is the largest emporium on the banks of the Brahmaputra and is where the produce of the surrounding country is collected for transmission to Calcutta. The export or downstream trade consists chiefly of tea, timber, oilseeds, caoutchouc, and raw cotton from Assam; and jute, oilseeds, tobacco, rice, and grain from Eastern Bengal.

The imports upstream are European cotton goods, salt, and hardware to Sirajganj; and rice, tea, seeds, liquors, etc., for Assam. Steamers run from Calcutta to Dibrugarh all the year through, the time occupied varying from 20 to 25 days.

Sandwip Island, about 14 miles long in a north-northwest and opposite direction, about 8 miles in width, and the largest of the islands or chars at the entrance of the Meghna, is low and fertile, and said to be free from tigers and other wild beasts. The principal village is on the eastern side; the coconut palm flourishes, and sugar cane is cultivated to a great extent.

This island and Hatia are particularly subject to inundation from storm waves.

Meghna River is the outlet of the main volume of the waters of both the Ganges and Brahmaputra, the main streams of the Brahmaputra or Jamuna and Ganges or Padma uniting at Goalunda, and entering the Meghna near Chandpur. The Meghna runs southward throughout its course, dividing eastern Bengal into two parts, and enters the sea by four principal mouths inclosing the three islands Dakshin Shahbazpur, Hatia, and Sandwip.

For some years the Meghna has shown a tendency to shift its channel gradually westward, and near Noakhali the mainland is said to have advanced seaward 4 miles in 23 years.

Navigation.—The river is navigated by river steamers and native boats all the year round, but the navigation is difficult and dangerous, owing to the sea set up at high water, and at low water to snags and shifting banks: the most favorable time for navigation is between November and February.

Shahbazpur River branches from the Meghna immediately above Narnak Char, and flows between Dakshin Shahbazpur on the west, and Falcon Char, Surloki, and Hatia on the east.

Depths.—The entrance of this river has not been properly surveyed, but there seems to be a channel over the flats with a depth of about 15 feet at low water.

Sandwip Channel, formerly the navigable entrance to Meghna River, is now closed by sand banks.

Navigation is practicable as far as Narayanganj for steamers drawing 10 feet, but it is dangerous between February and November, when at spring tides a heavy bore is experienced in the lower parts of the river.

Pilots.—Native pilots, who are regularly employed in the coasting trade, can be obtained at Chittagong. The aid of local pilots or boatmen is necessary in this navigation.

Bars.—Owing to the continual alteration in the channels of the Meghna River, no useful directions for navigation can be given, but in March, 1902, the depths on some of the principal bars were as follows:

Pajamassa Bar, northwestward of Pajamassar Char, had a depth of 9 feet, the spring rise being 11 feet.

Hatia Bar, considered the worst between the entrance and Chandpur, and situated between Hatia and Surloki Islands, had 6 feet water in a very narrow channel, the spring rise being about 10 feet.

Lallon Bar, northwestward of Lallon and Falcon Chars, had a depth of 9 feet in its narrow, tortuous channel, the rise at springs being about 8 feet.

Between Chandpur and Narayanganj are several narrow, intricate, and shoal bars, those having the least depth over them being situated at $3\frac{1}{2}$ miles above Chandpur and $4\frac{1}{2}$ miles below Narayanganj.

Tides.—It is high water, full and change, approximately, at the following places:

Hatia Bar, 3 h. 0 m.; springs rise about 10 feet.

Pajamassa Bar, 2 h. 10 m.; springs rise about 11 feet.

Mills Point, 4 h. 0 m.; springs rise about 7 feet.

Chandpur, 6 h. 30 m.; springs rise about $5\frac{1}{2}$ feet.

Narayanganj, 8 h. 30 m.; springs rise about 3 feet.

The bore in the outer channels of the Meghna is very strong for four days at spring tides, and its influence is felt to a little beyond Ilsa River or about 50 miles below Narayanganj. Rushing with violence as a high-crested wave, the Sandwip Channel bore meets another passing up between Hatia and Sandwip Islands, and off the northwestern end of Sidi forms a dangerous whirl. Between November and February the bore is less high and is not considered dangerous.

At the time of the equinoxes, especially with a southerly wind, the bore attains its greatest development when it advances like a wall topped with foam estimated to be nearly 20 feet high, at the rate of 15 miles an hour. In a few minutes the wave has passed, and the tide has changed from ebb to flood.

The bore was observed from an anchorage at Hatia Bar, at three days after new moon, extending completely across Shahbazpur River, being from 3 to 4 feet in height on the shoal flats, but somewhat less in deep water, and only breaking occasionally; its estimated velocity was from 5 to 6 knots, and it is probable that it is comparatively slight in this river.

The storm wave, which occasionally sweeps up the Meghna River in the wake of cyclones is even more dangerous than the bore; it is also most liable to occur at the break of the monsoons in May and October, and the most disastrous on record occurred on the night of October 31, 1876, when two or three waves came on in succession, flooding in one moment the entire country and destroying on the islands of Sandwip and Hatia and a portion of the mainland the estimated number of 100,000 persons.

Chandpur, a town situated on a creek of the same name, is rapidly rising in importance, and in 1901 had a population of about 7,000.

Communication.—Chandpur is one of the principal stations of the Indo-General S. N. Co.'s steam vessels, which connect with the railway systems at Goalunda and Narayanganj; it is also the terminus of the Assam-Bengal railway from Comilla.

Coal and supplies.—A supply of Bengal and Assam coal may be procured. Fresh provisions and water can be obtained.

Narayanganj, on the west bank of the Lakhya, extends for about 3 miles along the river, is a place of transshipment for country produce, particularly jute, and piece goods, salts, and European wares are distributed; there are several mills and steam jute presses, the bulk of trade being in the hands of native merchants. The population in 1901 was 24,472.

Communication.—There is daily postal and inland steam communication with Calcutta, steamers towing large flats laden with cargo. A railway runs northward to Mymensingh and Singhjani, and a steamer service connects with the railway to Calcutta at Goalunda Ghat.

Storm and weather signals are shown at Narayanganj. (See Chapter I.)

Chittagong District coast line, extending for a distance of about 135 miles in a south-southeast direction from the mouth of the Fenny River, has ports at Chittagong and Cox's Bazar.

Coast.—Sitakund Mountain, on the mainland about 13 miles eastward of the north end of Sandwip Island, is about 3 miles inland and 1,155 feet high; a ridge of hills extends southward from it at about the same distance from the sea.

Nagarkona, 289 feet, and Fakir Hill, 239 feet high, and marked by pillars, known as Goods Pillars, 20 feet high and painted black, are at the southern end of the ridge and northward of Chittagong.

A white sandy beach borders the shore, and at about $2\frac{3}{4}$ miles northward of Patunga Point, Mabesh Kalle Creek, which joins Karnaphuli River below Chittagong, enters the sea.

Chittagong Approach.—Excepting a narrow vein of deeper water, from 1 mile to 3 miles in width, which extends to the northward near to the coast for a distance of about 20 miles, its northern end being about 30 miles southward of Chittagong, the approach is generally in depths of less than 10 fathoms for a distance of 50 miles.

On the western side of this approach is the shoal water, with depths under 5 fathoms, extending southeastward of Meghna Flats, and on the eastern side outlying dangers from the mainland named South Patches, North Patches, and Dolphin Shoal, the 5-fathoms contour line is about 15 miles south-southwestward of the entrance to the river.

The tidal streams in this part of the bay set northward and southward with the trend of the land, with a rate at springs of 5 and 6 knots an hour, and in hazy weather vessels have been swept past Chittagong by the flood or north-going stream, and set upon the sands westward of Sandwip Island, without sighting either Kutubdia Island light by night, or the land by day.

Lights.—A lightvessel marks the west side of South Patches and exhibits a fixed white light.

On the western side of Kutubdia Island, 20 miles southward of Karnaphuli River Entrance, a group flashing white light is shown. (For details see Light List.)

A small brick tower, 47 feet in height and painted white, situated $1\frac{1}{4}$ miles south of Norman Point, Karnaphuli River Entrance, exhibits at an elevation of 55 feet above high water an occulting white light, visible 10 miles. (For details see Light List.)

Patunga Point, the northern high-water entrance point of Karnaphuli River, is low, flat, cultivated in places, with few trees, and a grassy plain extends some miles inland from its blunted southern point. A sand and mud flat surrounds the point, its southern end being nearly $1\frac{1}{2}$ miles south-southwestward of the point.

Beacon.—Patunga Beacon, standing close to the southern edge of the point, is 78 feet in height, painted white, and surmounted by a triangle, apex upward.

Norman Point is $1\frac{1}{2}$ miles northward of the lighthouse, and between the coast is composed of sandhills from 10 to 18 feet high, backed by a strip of grass and mud, which covers at extraordinary spring tides; a sandflat, about $\frac{1}{4}$ mile in width, fronts the sandhills.

Four-tree Hill, 127 feet high, and with four trees on it, is 2 miles east-northeast from Norman Point and appears from the river to form the southern limit of an extensive tableland, of which Juldia Hill forms a part.

Signal station.—A signal station and flagstaff, which is 100 feet high, are situated on Juldia Hill.

Storm, weather, and tidal signals are shown.

Outer anchorage.—In case of necessity anchorage may be obtained anywhere off the river entrance in a depth of 5 fathoms with good holding ground.

Directions.—Whatever the state of the weather or time of the year, but especially during the southwest monsoon, or from April to September, the greatest care is necessary in making Karnaphuli River.

Even with favorable weather and the position known, strict attention to the depth as well as to the course and distance made over the ground by using the ground log is necessary.

The lightvessel marking South Patches, if reliable, should be of great assistance in approaching the river, as Kutubdia Light is sometimes obscured by fog and mist, but it might be safer to make the land in the daytime if possible, as the approach to the outlying dangers already mentioned is not indicated by the soundings.

If the position is doubtful and the ground log denotes a strong flood or north-going stream it is well to anchor to avoid being set on the shoals extending from Sandwip Island and Meghna River

Entrance, which latter may extend farther southward than the chart indicates.

In the southwest monsoon, from the southward in cloudy weather and with no observations, the white cliffs at Cox's Bazar may be sighted; then pass between North and South Patches, and outside Dolphin Shoal, using the lead and considering the tidal streams.

Caution.—During the northeast monsoon it occasionally happens that small fog banks or thick mists occur on the Chittagong Coast, causing the lights in some instances to appear a deep red color and at others entirely obscuring them.

Karnaphuli River, the most important river in Chittagong district, rises in a lofty range of hills to the northeast, and, after pursuing a tortuous course, enters the district of Chittagong at Chandraguna Village.

Karnaphuli River is navigable throughout the year by boats of about 4 tons to Kasalang, a distance of 100 miles from its mouth. About 20 miles above Kasalang navigation is stopped by Barkal Rapids. Above Barkal the stream narrows, its course being north until the Demagiri Falls, three days' journey from Barkal, are reached, above which the river becomes insignificant.

The chief tributaries are Kasalang, Chingri, Kaptai, and Rankheong Rivers, of which the two first are navigable by boats. Below Barkal Rapids the Karnaphuli flows in a bed composed of mud and sand, and its banks, covered with jungle, rise to a height of 60 feet. The tide is felt as far as Kasalang, and the stream is sluggish except during the rains, when it is rapid.

Western bank.—From Patunga Beacon the western bank of the river trends eastward for $\frac{3}{4}$ mile, and then turns to the northward for 2 miles to Goaptu Point, eastward of which Active Spit extends for a distance of about $\frac{3}{4}$ mile into the river.

Between Goaptu Point and Chittagong six creeks enter the river on the western bank.

Eastern bank.—A creek, navigable by large boats, enters the river close to Norman Point, and near its mouth is Pavki Village, with another $\frac{1}{2}$ mile eastward of it, which has a large and conspicuous tree near its western end.

From Norman Point the eastern bank of the river curves northward for a distance of 2.4 miles to Juldia Hill, and northward of the point large mud flats stretch out into the river, and embankments have been constructed to prevent inundation; there are several small villages on this bank.

The eastern bank from abreast Goaptu Point becomes low and swampy, but is cultivated; mud islands, known as chars, the largest of which are Goaptu and Lukia Islands, lie off this bank, with a boat passage at high water between.

Tide gauge.—Off Juldia Hill Station, on the edge of the mud bank, is a tide gauge marked in 3 feet divisions, by which the tidal signals governing the entry and departure of vessels are made.

Coombs Pillar, about $\frac{3}{4}$ mile northward of Juldia Hill, on the highest part of the ridge, is 15 feet high, painted white, and surmounted by a lantern about 118 feet above high water.

Entrance.—Middle Bank, a mud flat, 2.1 miles in length in a northeast and opposite direction, and about $\frac{1}{2}$ mile in greatest width, the highest part of which is awash at high water, spring tides, occupies the middle of the entrance, between the sand and mud flat extending southward of Patunga Point and the mud flat off Norman Point, and there is a channel into the river on each side of this flat, the outer bars being at the seaward entrance of the channels.

Bars—Depths.—The outer bar of the northern of the two channels, which is the deeper, and that generally used had, in December, 1913, a depth of 10 to 12 feet over it; the outer bar of the southern channel has a charted depth of about 8 feet.

The inner bar, above Middle Bank, had, in December, 1913, a depth of about $12\frac{1}{2}$ feet over it, but the bars are subject to changes, and vessels of from 25 to 26 feet draft could enter the river at high water, spring tides from May to September; but in the dry season at neaps it only admitted vessels of about $18\frac{1}{2}$ feet draft. A large steam dredger is used for the improvement of the channels.

In January, 1915, there was a depth of 12 feet on Goaptu Crossing.

The water is lowest from November to June, and the depths are about 2 feet greater from July to October; in strong southwesterly winds a confused and dangerous sea breaks on the outer bars.

Beacons.—Leading beacons mark the channels of the river as far as Goaptu Crossing, eastward of Goaptu Point. The front beacon for use in crossing the outer bar of the northern channel is situated about 400 yards northwestward of Coombs Pillar, and is a pole beacon surmounted by a white disk.

The rear beacon on a hill, 237 feet high, and 1.1 miles from the preceding, is a pole beacon surmounted by a black diamond; these beacons in line lead over the outer and inner bars. In November, 1912, these beacons were in line, bearing 43° .

Batten Beacon, about 400 yards southwestward of Coombs Pillar, is a beacon with horizontal crosspieces, and in line with Coombs Pillar bearing 49° leads over the inner bar.

Two beacons for leading eastward of Active Spit are situated on the east bank of the river, about 1,800 yards eastward of Goaptu Point. The front beacon is a pole beacon, surmounted by a triangle, apex upward, and painted white.

The rear beacon, a cross surmounted by a ball, painted white, in line with the front beacon bearing 24° , leads eastward of Active Spit.

The front beacon for leading over Goaptu Crossing is a white tripod surmounted by a drum, the rear beacon is surmounted by a cask above two battens, painted white; these beacons in line (January, 1915) bearing 115° lead over Goaptu Crossing. They are frequently moved.

Buoys.—A fairway buoy, painted black, is moored on the line of the leading beacons on the outer edge of the outer bar.

The channel of the river to Chittagong is marked by red buoys on the starboard hand, and black buoys on the port hand, entering from seaward, but the buoys are liable to be washed away, and are moved as changes occur.

A conical black buoy is moored between Active Spit Buoy and Goaptu Crossing Buoy.

A red mooring buoy has been moored in about 24 feet of water 865 yards 243° from Coombs Pillar.

Anchorage are charted in the reach southward of Active Spit, in a depth of about 42 feet, and westward of the southwest end of Goaptu Island, in about 36 feet, and the anchorage fronting the town is about 3 miles in length, with depths of from 18 to 36 feet, but an area of rocky bottom, at Ring Bar, near the western end of the town, affords no anchorage.

Moorings.—There are 3 fixed and 8 swinging sets of moorings for large vessels below Chittagong. The mooring buoys are painted black, and are much larger than the buoys marking the channel.

Tug.—A tug is available.

Pilots.—In the southwest monsoon pilots cruise in their cutter by day, weather permitting, from the outer bar of Karnaphuli River to Sangu River Mouth. In the northeast monsoon the cutter remains at her station by day and night, 3 miles southwestward of the outer bar buoy. The pilot cutter carries a red and white flag at the masthead.

Directions.—As the entrance of the river is liable to constant change, the bar can not be crossed or the river navigated without local knowledge, and it should not be attempted without a pilot. The leading beacons, which have been already described, and sketches of which are given on the chart, should be a guide when entering the river.

The best time to cross the bar is at high water slack, and next to this on the first of the ebb. The tidal streams set across the outer part of the bar, the flood north-northeastward, the ebb south-southwestward, and at springs the flood streams are strong and are apt to sweep vessels northward and westward of the river entrance.

Sailing vessels are sometimes detained in leaving the river during the southwest monsoon, owing to the unfavorable wind. A land breeze from the northward may generally be expected at night.

Tides.—It is high water, full and change, on the outer bar at Karnaphuli River Entrance at about 0h. 30m.; springs rise 14 to 16 feet, and neaps 9 to 11 feet.

At Juldia tide gauge it is high water at 0h. 40m.; springs rise 13 to 15 feet, neaps 7 to 10 feet.

At Government Pier, Chittagong, it is high water at 1h. 12m.; springs rise 12 to 14 feet, neaps 6 to 8 feet; the rise given is above the zero of Juldia tide gauge, which is equivalent to low water springs of the dry season (November to April).

During the southwest monsoon, April to October, extraordinary spring tides have been known to rise as much as 19 feet above the zero.

The tides at Chittagong are subject to a large diurnal inequality, which may either accelerate or retard the times of high and low water sometimes more than an hour.

From September to March the night tides are higher than the day tides; in December and January at springs the difference is about 2 feet.

From March to September the day tides are higher than the night tides; the difference is greatest in June and July at springs.

Tidal streams.—About $\frac{1}{2}$ mile westward of the outer bar, the flood stream sets north-northwest and the ebb stream south-southeast.

The tidal stream turns about $1\frac{1}{2}$ hours after high and low water near Juldia and $1\frac{1}{4}$ hours after high and low water at Chittagong. During the rainy season, April to September, the rate of the ebb stream is great. Under ordinary conditions the rate of the tidal streams is about 2 knots at neaps and 3 to 4 knots at spring tides.

Town.—The town of Chittagong, also known as Islamabad, is one of the most picturesque towns in the plains of India, being large, beautifully situated, and interspersed with trees and tanks. The European houses are built on hills 150 to 200 feet high, covered with vegetation, and in the hollows are native huts amidst fruit trees.

The town, extending over an area of $4\frac{1}{2}$ square miles, is a collection of small villages interspersed with paddy fields and small hills, but in the European portion are gardens, a church, and hospital, and the offices of the Assam-Bengal Railway, and being not only the principal civil station in the district, but also the administrative headquarters of a division, it contains a number of offices and numerous buildings of modern date; there is also an old fort and several mosques.

The town is badly lighted, but a scheme of electricity is proposed, using the river water as power. In 1901 the population was 22,104.

Communication.—The steamers of the British India Co., between Calcutta and Rangoon, call weekly, and touch at Akyab, Kyaukpyu, and Sandoway, and there is also a regular service to these ports by

vessels of the Asiatic Steam Navigation Co. The Bengal Steam Navigation Co. run steamers between Chittagong and Burmese ports. Steamers of the Clan Line visit the port regularly.

Chittagong is the terminus of the Assam-Bengal Railway. There is railway communication with Calcutta by a branch line from Laksham, 81 miles from Chittagong, to Chandpur, thence by steamer to Goalunda, from which the Eastern Bengal Railway runs to Calcutta.

There is a daily post to Calcutta, and telegraphic communication with all parts.

Coal and supplies.—From 100 to 500 tons of coal are kept in stock, and about 1,000 tons imported annually; there are 30 lighters holding from 25 to 150 tons. Arrangements for oil fuel can be made with the Burma Oil Company.

Fresh provisions may be procured at Chittagong at moderate prices, and fresh water is supplied by the port department; water of good quality may be obtained from the railway jetty and from the port depot; there is also a steam water boat. For washing purposes the water in the river at the last of the ebb, about 2 miles above the town, is sufficiently good. Ship chandler's stores are procurable.

Pier.—The railway wharf at Chittagong is 360 feet long, with a depth of 25 feet alongside it at low water ordinary springs. There are 4 hydraulic cranes at the wharf, 3 of which can lift $1\frac{1}{2}$ tons, and one 5 tons at full radius and 10 tons at half radius. There are sheds on the wharf in which about 5,000 tons of cargo might be stored.

Only 3 jetties are available for ocean steamers, and one of these is reserved for steamers of the Clan Line.

Storm signals are shown from the town port flagstaff and Juldia Signal Staff.

Repairs.—Ordinary repairs can be executed to boilers and machinery, and there are sheers which will lift 12 tons. Vessels up to about 1,400 tons can have their bottoms repaired by beaching on a bank of hard sand. Important repairs could probably be carried out by the Assam-Bengal Railway Co.'s works, which are situated about 4 miles from the town and connected by railway. Carpenters are procurable.

Hospital.—Seamen are treated at the municipal hospital.

Quarantine.—Vessels with plague must anchor at Juldia until inspected by the health officer.

Trade.—The chief exports are rice, jute, and tea; and the imports salt, railway materials, and kerosene oil.

All cargo is loaded and discharged at the wharf or by means of lighters and native boats.

Health.—The native town of Chittagong is considered unhealthy from the malaria arising from stagnant pools and tanks, and also

from the extensive chars, but the port is not worse in this respect than other river ports of India. Vessels visiting Chittagong are permitted the attendance of a Government surgeon at a moderate charge.

The most unhealthy period of the year is September, or toward the close of the rainy season, when fever is prevalent. In April and May epidemics of smallpox and cholera are common. An easterly wind, if of long continuance, is said to be unhealthy. (See Chapter I.)

Winds, weather, and climate.—During the southwest monsoon the rainfall is generally heavy, averaging 105 inches. A sea breeze usually prevails during the day and renders the air comparatively cool. The atmosphere is frequently saturated with moisture, causing heavy dew at night and occasionally dense fogs.

Southwesterly winds prevail from March to May; southeasterly to southwesterly from June to September; and northeasterly from October to February. The weather is fine and settled from the middle of October to March; but toward April the wind becomes more easterly, with occasionally heavy northwesterly winds in the afternoon. After about the end of April the southwest monsoon blows fresh in the upper part of the Bay of Bengal; but there are land and sea breezes near the land in the northeastern part of the bay.

Near Chittagong in the forenoon the wind generally blows from the southeastward and is moderate; toward the afternoon it freshens and veers to the southwestward. In June and July the southwest monsoon blows hard from south-southeast to southwest, with rain, leaving now and then a few comparatively fine days.

Cyclonic storms.—Although Chittagong is in the track of cyclones, serious injury is not often caused by them. But in 1849, 1872, and 1876 severe cyclones, accompanied by storm waves, worked great havoc in the district, and much damage was similarly caused in 1897.

Coast.—From Chittagong Lighthouse, which is situated $1\frac{1}{2}$ miles southward of Norman Point, the coast trends south-southeastward for a distance of $4\frac{1}{2}$ miles to the northern entrance point of Sangu River; this point is broad, flat, and fringed with extensive sand flats.

Sangu River.—The entrance to Sangu River, though almost filled with sand banks at low water, appears, when these banks are covered, to be about 3 miles wide. The river is navigable by large cargo boats throughout the year and connects some distance up by a partly artificial channel with the Karnaphuli River.

Coast.—The coast southward to Kutubdia Island is low and without any noticeable marks; about 9 miles from Sangu River northern entrance point, it recedes and is broken up by numerous shallow streams.

Kutubdia Island, the north point of which is about 12 miles southward of Sangu River northern entrance point, is 12 miles in length in a north-and-south direction, and from 2 to 4 miles in width; it is low and level, covered with trees, and visible from a distance of about 8 miles. The island, being liable to inundation, is protected by a ring of embankments from encroachment by the sea.

The channel inside Kutubdia Island, about 2 miles in width, appears blocked, but there may be an entrance from the southward.

Light.—On the western side of Kutubdia Island and about 2 miles from its northwestern point, a brick tower, 136 feet in height, painted with its lower story gray and its upper part in red and white horizontal bands, exhibits at an elevation of 121 feet above high water, a group flashing white light, visible 17 miles. (For details see Light List.)

Shoal.—A shoal, with a depth of 3 fathoms over it, lies 7 miles north-northwest of Kutubdia Lighthouse, and there are depths of $3\frac{1}{2}$ fathoms 1 mile northward of it and of 4 fathoms between it and Dolphin Shoal.

Tides.—It is high water at Kutubdia Island at 11h. 56m.; springs rise 13 feet, neaps rise $9\frac{1}{2}$ feet.

Dolphin Shoal, nearly 4 miles westward of Kutubdia Lighthouse, is about 2 miles in length in a north and south direction, half a mile in width, and has a depth of 4 feet over its shoalest part at low water.

The channel between the shoal and Kutubdia Island is 3 miles wide, with depths of from $5\frac{1}{2}$ to 7 fathoms.

Buoy.—A large conical buoy, painted white and surmounted by a small black cage, is moored in a depth of 4 fathoms, westward of the southern part of Dolphin Shoal, and $4\frac{1}{4}$ miles westward of Kutubdia Lighthouse.

This buoy is liable to be washed away.

Anchorage may be obtained in a depth of 7 fathoms with Kutubdia Light bearing 67° distant about 1 mile, approaching it with the lighthouse or light on that bearing; this leads over the northern part of a ridge with a depth of $4\frac{1}{4}$ fathoms over it, which is situated 3 miles south-southwestward of Dolphin Shoal and is so narrow that the lead may easily miss it. The anchorage is fairly protected, but the tidal streams run as strongly as outside the shoals.

North Patches extend southward for a distance of 12 miles in a broken tongue from their northern extreme, situated about 4 miles west-northwestward of the south point of Kutubdia Island. The depth of water on North Patches varies from 4 feet to $2\frac{3}{4}$ fathoms, over hard sand.

A channel about $\frac{3}{4}$ mile wide, having depths of from 6 to 17 fathoms, separates North Patches and the sands extending off the south end of Kutubdia and westward from Maiskhal Island. The

tidal streams rush at a great rate through this channel, and it should not be attempted without local knowledge.

South Patches are three heads of hard sand extending for about 5 miles in a north and south direction, the northern patch, with $1\frac{1}{2}$ fathoms water over it, being 10 miles westward of the north end of Sonadia Island. The middle of these heads, having a depth of 3 fathoms over it, is about $1\frac{1}{2}$ miles southward of the northern patch, and the southernmost head, with $4\frac{1}{2}$ fathoms over it, at low water is $2\frac{1}{2}$ miles distant from the middle head.

In fine weather there are generally rollers near the South Patches, and in a fresh breeze the shoaler parts have breakers upon them. Around South Patches there are depths of $6\frac{1}{2}$ to 10 fathoms, over mud.

Lightvessel.—A lightvessel, painted red, with a black ball at the masthead, and "South Patches" in white letters on the sides, is moored westward of the shoal, and exhibits a fixed white light, visible 11 miles.

A blue light is burned every half hour from 7 p. m. to 5 a. m. The light vessel is removed annually from the end of December to the middle of March and replaced by a conical buoy, painted red and surmounted by a staff and cage.

Buoy.—A conical buoy, painted red, and surmounted by a white cage, is moored in a depth of 9 fathoms, about 1 mile southwestward of the 3-fathom patch of South Patches; it is liable to be washed away.

Trifels Shoal.—A shoal, with a depth of $5\frac{1}{2}$ fathoms over it, was reported (1907) about 14 miles southwestward of South Patches.

Tides.—At South Patches springs rise 12 feet.

Tidal streams.—The flood or north-going stream continues to run northward and northeastward for one hour after high water, and the ebb or south-going stream runs south-southwestward and southwestward for $1\frac{1}{2}$ hours after low water. At springs the streams run northward and southward; at neaps the streams gradually turn in the direction of the hands of a watch. In the fine season more westerly than easterly set is experienced. The rate of the ebb at springs is estimated at 4 to 6 knots; and at neaps about $2\frac{1}{2}$ knots an hour.

Maiskhal Island, the northern part of which is southeastward of Kutubdia Island, with Mattabari Island between, is 13 miles long and 6 miles broad, and through its center and along the eastern coast is a range of low hills, about 300 feet high, but the west and north coasts are low-lying and fringed by mangrove jungle; the greater part of the island belongs to a permanently settled estate. In 1901 the population was 22,228.

Maiskhal Village, the police headquarters, has a shrine dedicated to Siva, and on the same hill is a Buddhist pagoda.

Garamchori Hill, near the middle of the eastern part of the island, is 288 feet in height, but as the range is somewhat uniform it is not remarkable.

Maiskhal Channel, separating Maiskhal Island from the mainland, is 1.1 miles in breadth at the southern point of that island, but the deeper part, with 5 fathoms water, is only 600 yards in breadth and lies on the eastern side; this channel extends to Baghkhali Creek, where it is narrowed to the breadth of 200 yards.

Sonadia Island, situated 2 miles off the southwest extreme of Maiskhal Island, is $3\frac{1}{2}$ miles in length in a northwest and opposite direction, and about 400 yards in width; it has white sand hills from 5 to 15 feet high and two conspicuous coconut palms near its southern end.

Red Crab Island, 1 mile in length, is narrow, sandy, and lies close to the southeast point of Maiskhal Island; a large fishing village is situated on the island.

Rupadia Sands, forming the southwest side of the entrance to Maiskhal Channel, extend from the southern coast of Maiskhal Island, and cover at high water, except a small patch awash at their northern end.

The sands are triangular in shape, $2\frac{1}{2}$ miles in length in a north and south direction, about 1 mile in breadth, and the sea generally breaks over them.

Inner Spit, about $\frac{1}{2}$ mile in length in a north and south direction, its northern part awash at high water, and always visible, lies about 700 yards southeastward of the south point of Rupadia Sands, part of the channel between having depths of from $3\frac{1}{2}$ to $5\frac{1}{4}$ fathoms.

Middle Shoal, about $1\frac{1}{2}$ miles in length in a northeast and opposite direction and 800 yards in breadth, is composed of sand and mud, with depths of from 1 foot to 12 feet over it, and lies midway between Red Crab Island and the mainland.

Middle Sands, $\frac{1}{2}$ mile in length in a north and south direction, and 500 yards in breadth, dries at low-water spring tides, and is situated near the southern end of Middle Shoal.

Baghkhali Creek, running into Maiskhal Channel opposite Red Crab Island, is narrow, shallow, and nearly dries in places at low-water spring tides.

Beacon.—Coxs Bazar Beacon, consisting of a wooden post, surmounted by a cross, painted white, is 174 feet above high water, and situated on the northern part of the coast range of hills; it is not easily distinguished from beyond a distance of 4 miles.

Entrances—Depths.—The principal entrance to Maiskhal Channel is situated between the Inner Spit and the mainland, over a bar of sand, which probably shifts during the southwest monsoon; in

1902 there was a depth of 12 feet at low-water spring tides, in this channel.

The channel between Rupadia Sands and Inner Spit had, in 1902, a depth of 7 feet over its bar. There are generally heavy rollers off the entrance to Maiskhal Channel, which within the depth of 3 fathoms break occasionally on parts of the bar.

Anchorage.—Vessels of deep draft can anchor in a depth of $5\frac{1}{2}$ fathoms, over sand and mud bottom, about $3\frac{1}{2}$ miles off Coxs Bazar, with the two coconut palms on Sonadia Island bearing 333° , and Coxs Bazar Beacon 73° .

The anchorage for vessels of light draft is in 3 fathoms water, over sand and mud bottom, $\frac{1}{2}$ mile from the shore, with the four conspicuous casuarina trees, situated $1\frac{1}{4}$ miles north-northwest of Coxs Bazar, bearing 5° , and Coxs Bazar Beacon 108° ; or anchorage may be taken up off the entrance to Baghkhali Creek in a depth of 4 fathoms, over mud.

Directions.—Reliable pilots for Coxs Bazar can not be obtained, and as the bar probably shifts its position, the channel should be examined and buoyed before entering. According to the position of the bar as at present known, the following directions are suitable:

Approach the coast with the north extreme of White Cliffs bearing 90° until the summit of Coxs Bluff bears 0° , when steer for it until the four conspicuous casuarina trees bear 348° , and then alter course to 338° , keeping from $\frac{3}{4}$ to $\frac{1}{2}$ mile from the shore, until the anchorage for vessels of light draft is reached.

If intending to anchor off Baghkhali Creek, the anchorage off Coxs Bazar should be left at half tide, when the edge of Rupadia Sands will be visible, and the channel should be crossed, steering 304° , avoiding the Inner Spit. Follow around the edge of Rupadia Sands, and that of those extending from Maiskhal Island, at a distance of about 300 yards, until the south end of Red Crab Island bears 291° , when cross the channel, keeping clear of Middle Shoal, and proceed to the anchorage.

Tides.—It is high water, full and change, in Baghkhali Creek at 10h. 35m.; springs rise from 11 to 12 feet; neaps rise from 7 to 9 feet.

Coxs Bazar, prettily situated on a low range of sand hills, between Baghkhali Creek and the sea, where it has a long open beach, is likely to become a popular health resort for Chittagong. The houses are well and solidly built of timber, raised on piles, and surrounded by verandas, having somewhat the appearance of Swiss cottages; it has substantial offices, civil and criminal courts, and other buildings, and in 1901 the population was 3,845.

Communication.—The Retriever Flotilla Co. have a regular service of steam vessels with Chittagong twice weekly, and there is a post and telegraph office.

Supplies.—Small supplies of fresh provisions and water may be procured, and a large variety of fish, including pomfret, soles, and oysters, are obtainable.

Storm signals are shown at Cox's Bazar.

Coast—White Cliffs.—The coast at a distance of 4 miles south-southeastward of Cox's Bazar forms cliffs of red earthy clay, which extend for a distance of $3\frac{1}{4}$ miles, with an average height of over 200 feet; South Cliff, the highest part, is 270 feet high. Seen from seaward, these cliffs appear white when the sun is shining on them, and as in clear weather they may be visible from a distance of 20 miles they constitute a good landmark for vessels approaching Chittagong from the southward.

Tides.—It is high water, full and change, near White Cliffs at about 11h. 0m.; springs rise from 9 to 10 feet.

Regu Shoal, about 5 miles south-southwestward of White Cliffs, is about 2 miles in length, in a north and south direction, and $\frac{1}{2}$ mile in width; it is composed of rock and hard sand and has a least depths of $2\frac{1}{2}$ fathoms over it at low water, spring tides.

Elephant Point (Dombak), 9 miles southward of South Cliff, has behind it a conspicuous hill, 410 feet high, which may be seen in clear weather from a distance of 20 miles.

A ledge of rocks extends for a distance of nearly 600 yards, and there is a depth of 5 fathoms at 1,200 yards from the point.

Signal station.—There is a signal station on Elephant Point, belonging to the Indian Telegraph Department, and vessels can communicate by the International Code.

Kohinur Shoal, with a depth of 12 fathoms, over sand, was reported (1909) about 23 miles westward of Elephant Point and outside the 20-fathom contour line.

CHAPTER V.

COASTS OF ARAKAN AND BURMA—ELEPHANT POINT TO CAPE NEGRAIS.

Coast.—From Elephant Point the coast trends southeastward for a distance of 11 miles to abreast Taungnyo (Quoin Hill), which is 880 feet high and situated 2 miles inland, and thence south-southeastward 22 miles to Shahpuri Point, the south extreme of Shahpuri Island.

Naaf Peninsula, of which this coast is the western side, is from 2 to 5 miles in width and hilly; a conspicuous peak, 830 feet high, is situated on it, about 9 miles southward of Taungnyo, and near the south end of the peninsula are the North Twins, two remarkable casuarina trees.

A range of mountains, of which Walkyeingtaung, 1,515 feet high, and the northern end, is 11 miles east-northeastward of Taungnyo, stretches southward in a direction almost parallel to the coast, but gradually drawing toward it; the general heights of the summits are from 1,000 to 2,260 feet.

Depths offshore.—The 10-fathom contour line, which is about 6 miles from Elephant Point, gradually draws off the land, and is about 11 miles westward of the west coast of Shahpuri Island; inside it the depths, principally over a muddy bottom, shoal evenly to the coast, without any outlying dangers, except Shahpuri Flat, which commences immediately northward of Shahpuri Island.

Shahpuri Island, about $4\frac{1}{2}$ miles in length in a northwest and opposite direction, and $2\frac{1}{2}$ miles in greatest width, is low, flat, covered with jungle, and separated from the end of Naaf Peninsula by a narrow creek, which dries in places at low water; South Twins, two conspicuous trees, about 80 feet high, are near its southwest side, and Badar Clump of casuarina trees, about 90 feet high, is close to Shahpuri Point.

Shahpuri Flat, of sand and mud, with general depths of from $1\frac{1}{2}$ to $2\frac{3}{4}$ fathoms over it, is triangular in shape, and from the coast of Naaf Peninsula, about 6 miles northwestward of Shahpuri Point, its edge has a southerly direction for about 8 miles to the apex, which is 5 miles southwestward of Shahpuri Point: its southern part forms the bar at the entrance to Naaf River.

A shoal part, on which the depths are less than 1 fathom, extends about 1 mile westward of the South Twins and breaks, and there are generally heavy rollers on the flat, which also often breaks in a depth of 2 fathoms.

Cypress Point, the eastern entrance point to Naaf River, is low and sandy, and close to it is a Cypress Clump, of casuarina trees, about 80 feet high. Best Clump, the trees of which are about 80 feet high, is a conspicuous clump about 3 miles southeastward of Cypress Point.

Cypress Sands, a number of ridges, some of which uncover at half tide and other that dry at low water, spring tides, lie on a bank nearly 3 miles in width, with depths under 3 fathoms, which extends about $3\frac{1}{2}$ miles west-southwestward of Cypress Point, and the same distance southward of it; these sands form the south side of the channel into Naaf River, after crossing the bar, and when dry are seen by the broken water over them.

Naaf River, entered between Shahpuri and Cypress Points, nearly $1\frac{1}{4}$ miles apart, as far as surveyed, a distance of about 11 miles from its mouth, flows in a south-southeast direction, and has no outlying dangers in it.

Bar—Depths.—The bar, which is formed between the south point of Shahpuri Flat and the west extreme of Cypress Sands, is about 6 miles southwest of the entrance, and in 1903 had a depth of 13 feet over it at low water, spring tides. Inside the bar and about 4 miles from the entrance, the depths increase to from $3\frac{1}{4}$ to $4\frac{1}{4}$ fathoms, and between the entrance points there is a vein of deep water with from 11 to 17 fathoms, but the general depths in mid-channel of the river are from 5 to 8 fathoms.

Buoys.—A buoy is moored, in a depth of 13 feet, on the southern side of the bar, and is about $4\frac{1}{2}$ miles southwestward of Shahpuri Point.

An inner buoy is moored in 28 feet water, on the northwest edge of Cypress Sands, and on the south side of the channel; it is nearly 3 miles southwestward of Shahpuri Point.

These buoys are removed annually during the southwest monsoon.

Directions.—Approach the bar with Best Clump, the most conspicuous clump of trees southeastward of the entrance, bearing 88° , and when the northern point of St. Martins Islands bears 167° , alter course to 62° , passing about $\frac{1}{4}$ mile northward of the north edge of Cypress Sands, and when Shahpuri Point bears 349° steer to enter the river in mid-channel.

A channel with somewhat deeper water exists close westward of the western edge of Cypress Sands, but it is too narrow to be attempted unless previously buoyed.

Anchorage.—The anchorage off Maungdaw, the principal town, is in a depth of about $4\frac{1}{2}$ fathoms.

Tides.—It is high water, full and change, at St. Martins Islands at 9h. 28m.; springs rise from 8 to 10 feet, neaps rise from 6 to 8 feet. High water is 40m. later in Naaf River.

Tidal streams.—The tidal streams set across the entrance to the bar; the flood to the northward, and ebb to the southward, at rates of from $\frac{1}{2}$ of a knot to 1 knot at springs.

Town.—Maungdaw, the principal town in this district, is situated on Tat Creek, on the eastern side of the river, about 7 miles from its entrance; in 1908 the population was about 1,735.

Communication.—Steam launches communicate with Akyab and with Ucha, at the head of Naaf River, and there is a post and telegraph office.

Akyab District—Boundary.—Naaf River is the boundary between Bengal and Burma and the northwest limit of Akyab District, the coastline of which extends about 65 miles southward of its entrance.

St. Martins Islands, a group $3\frac{1}{2}$ miles in length in a north and south direction and about $\frac{1}{2}$ mile in greatest breadth at the northern end, consist of one large and two very small islets, connected by ledges of sand and rock, which dry at low water.

There is a clump of trees near the southern end of the group, several casuarina trees on other parts, and at the north end is North Tall Tree, about 110 feet high.

Landing.—Good landing may be effected at the northern end.

St. Martins Reef, situated $5\frac{1}{2}$ miles westward of the northern St. Martins Island, is a long ridge of rocks, one of which is awash at low water, spring tides; the reef breaks in heavy weather and with a southerly swell, but does not always do so in the northeast monsoon.

Foul ground extends 800 yards westward, 1,200 yards southward, 800 yards eastward, and $2\frac{1}{2}$ miles northward of the rock awash, the northern patches being detached, with depths of 5 fathoms over them.

North Delay Shoal, a small patch of hard ground 800 yards in length in an east-and-west direction and 400 yards in width, has a least depth of 4 fathoms over it and lies $6\frac{1}{2}$ miles southwestward of the south point of St. Martins Islands.

South Delay Shoal, a ridge with very irregular depths over it, but on which the least water obtained was $5\frac{1}{2}$ fathoms, lies about 2 miles southward of North Delay Shoal; as pinnacles with a less depth may exist in this locality, should not be crossed.

Coast.—Sitarparokia (Black Hummock), about $12\frac{1}{2}$ miles south-eastward of Cypress Point, is a small conical hill, 224 feet high, having the ruin of a temple on its summit; the hill appears black when

seen from the southward. A conspicuous rock, 20 feet high and shaped like a chair, lies $\frac{1}{2}$ mile northwestward of Sitarparokia and 200 yards from the shore.

Sitarparokia Patches, about $4\frac{3}{4}$ miles in extent in a north-northwest and opposite direction, with a greatest breadth of $2\frac{1}{2}$ miles, have a least depth of $1\frac{1}{2}$ fathoms over them, which is near the northern end, and about 7 miles from Sitarparokia, nearly on a line joining that hummock with the south point of St. Martins Islands. There are depths of from $4\frac{1}{2}$ to 5 fathoms between them and the mainland, and from $5\frac{1}{2}$ to 7 fathoms between them and St. Martins Islands.

Asirgarh Shoal, a small rocky shoal about $\frac{1}{2}$ mile in extent and on which there is a depth of less than 1 fathom, lies about $6\frac{1}{2}$ miles southwestward of Sitarparokia and breaks at low water and in heavy weather.

A patch of 5 $\frac{1}{4}$ fathoms lies 1.7 miles west-northwestward of Asirgarh Shoal.

Taylor Shoal, $2\frac{3}{4}$ miles in length in a west-northwest and opposite direction, and $1\frac{1}{4}$ miles in breadth, has a least known depth of $4\frac{1}{4}$ fathoms, which lies $7\frac{3}{4}$ miles northwestward of Oyster Island Lighthouse, but as the depths over the shoal are very uneven, less water may exist, and vessels should avoid passing over any part of it.

Oyster Island, situated 21 miles southward of Sitarparokia, is low, rocky, and of small extent, with a few low trees on its summit, and stands on the eastern edge, and near the center, of a ledge of rocks, 1 mile in length in a north-and-south direction and 600 yards in width.

The bank surrounding the island, inside the 5-fathom contour line, is about $1\frac{1}{2}$ miles in breadth, and extends the same distance northwest of the island and $3\frac{1}{4}$ miles southeast of it; inside the 5-fathom line are several shoals with from $1\frac{1}{4}$ to $3\frac{3}{4}$ fathoms water over them, and uneven bottom. A rocky patch of the former depth is situated 3 miles southeastward of the lighthouse.

Oysters are plentiful on the island.

Light.—From an iron tower 141 feet in height, painted black and white in horizontal bands, black at base, with white dome, situated on eastern side of the center of Oyster Island, is exhibited, at an elevation of 130 feet above high water, an occulting white light, with a red sector, visible 17 miles. A flagstaff, some buildings, and low trees are near the lighthouse. (For details see Light List.)

Pier—Landing.—Good landing may be effected in fine weather at an iron pier which extends from the northeastern side of the island.

Mayu River, from a position about 11 miles from its entrance, between Foul and Mayu Points, about $1\frac{1}{4}$ miles apart, for which distance it has been surveyed, flows about due south, and from about

a mile within its mouth the river is divided, for a distance of 8 miles, into two channels by Paw Kyun Thi Island, and a shoal extending south of it: as far as Paw Kyun Thi Island the river is about $1\frac{1}{2}$ miles wide, but above that island it narrows.

Kywide River, the eastern arm, which has been surveyed for a distance of 4 miles, is about 1 mile wide in breadth at that part, and flows in a west-southwest direction, joining the Mayu River immediately inside its entrance.

Aspect.—The coast range northward of Mayu River, which stretches from that direction parallel to the coast, has sharp summits, but these terminate 3 miles northward of Foul Point in a hill known as Fakirmura, 435 feet high, and easily recognized.

Mount Todd, 1,109 feet high and $4\frac{1}{4}$ miles northward of Fakirmura, when seen from the westward appears to be flat topped and slightly higher than the summits on either side of it, but from the southward it has the appearance of a conspicuous sharp peak.

The Agandu Range, 631 feet high, situated between the Mayu and Mosi Rivers, and 7 miles east-northeastward of Fakirmura, is flat topped and crowned by a pagoda.

Bengara, a conspicuous peak, 1,356 feet high, is 19 miles northeastward of Fakirmura, and when open southward of it is easily recognized.

Dangers.—Martini Sands, on which are Burne Rocks, and several patches which dry from 1 foot to 8 feet, extend for a distance of nearly 4 miles in a southerly direction from Foul Point, with a general breadth of 2 miles. These sands lie on the eastern side of a triangular-shaped bank, which, leaving the coast about 5 miles north-northwestward of Foul Point, stretches in a southerly direction for a distance of about 12 miles and terminates in North Spit, the point of which forms the western side of the bar; from North Spit the bank, with Martini Sands, forms the western side of the channel into the river.

Mayu Spit, which is awash at low water, spring tides, extends in a southwest direction for a distance of 2 miles from Mayu Point; it also lies on a triangular-shaped bank, which, $4\frac{1}{4}$ miles southwestward of Mayu Point, terminates in South Spit, the point of it forming the eastern side of the bar.

Bar—Depths.—The bar between North and South Spits is about $\frac{1}{4}$ mile in width, and has a depth of 19 feet at low water, spring tides; inside, the channel widens to $1\frac{1}{2}$ miles, but contracts to about 1,400 yards near Mayu Point, widening again in the river.

The depths increase inside the bar to 5 fathoms, and to nearly 13 fathoms westward of Mayu Point, shoaling again in the river to 5 and 6 fathoms at the anchorage between Foul Point and the point

of the shoal extending from the dividing point between Mayu and Kywide Rivers.

The channel eastward of Paw Kyun Thi Island and the shoal extending from it has a depth of 19 feet, and, although much obstructed by fishing stakes, is the easier to navigate. The channel to the westward of island and shoal has a depth of 20 feet, but its southern entrance is narrow and dangerous.

The depths in Kywide River are from 5 to 7 fathoms.

Anchorage.—Good anchorage may be obtained eastward of Burne Rocks, in depths of from 6 to 9 fathoms, also in a depth of 5 fathoms just to the southward of Nganabya Creek, nearly $\frac{1}{4}$ mile off the east bank, or in 4 fathoms at about the same distance off the west bank, opposite Rathedaung.

Directions.—The leading mark for crossing the bar is a distant bluff in line with a wooden pagoda, 271 feet high, bearing 1° ; the pagoda is situated about 1,400 yards eastward of Fakirmura, and at the right tangent of a clump of trees, which position makes it difficult to distinguish.

When Bengara comes in line with Pimple Hill, bearing 33° , steer for it until Mayu Point bears 158° , when alter course to pass eastward of Burne Rocks. Pimple Hill is situated about $1\frac{1}{2}$ miles south-eastward of Agandu.

If proceeding to Rathedaung, course may be shaped to pass on either side of Paw Kyun Thi Island, observing, as already mentioned, that the eastern channel is the better of the two.

Tides.—It is high water, full and change, at Foul Point at 9h. 47m.; springs rise from 8 to 9 feet, neaps rise 6 feet; neaps range from 2 to 3 feet. It is high water from 15 to 20 minutes earlier at the bar.

Tidal streams.—The tidal streams at the bar have a rate of about $2\frac{1}{2}$ knots at springs and $1\frac{1}{2}$ knots at neaps, the flood setting in a north-northeast, and the ebb in an opposite direction. In the river the streams attain a rate of $3\frac{1}{2}$ knots at springs.

Rathedaung Town is situated on the north bank of Rathedaung Creek, which enters by the east bank of the river at 12 miles above Foul Point; it has a population of about 1,200.

Communication.—There is communication with Akyab by steam launches, and a post and telegraph office.

Oyster Reef, nearly 12 miles south-southwestward of Foul Point, is a dangerous reef, about $2\frac{1}{2}$ miles in length in a northwest and opposite direction, within the 5-fathom contour line, on which a depth of 4 feet has been reported, but the least depth found at the survey, in 1904, was $1\frac{1}{2}$ fathoms; it always breaks in bad weather, or if there is any swell.

It is covered by a red sector from Oyster Island Light.

Buoy.—A white can buoy, with staff and cage, is moored at the southern end of this reef.

This buoy is withdrawn from May 1 to November 1 annually.

The channel between Oyster Reef and the foul ground extending southeastward of Oyster Island is $4\frac{1}{2}$ miles wide, with depths of from 7 to 8 fathoms.

Heckford Patch, $1\frac{1}{2}$ miles in length in an east and west direction, is composed of rock, and the least water found over it in 1904 was 5 fathoms, which was situated $8\frac{3}{4}$ miles south-southeastward from the shoalest part of Oyster Reef; a depth of $4\frac{1}{2}$ fathoms has been reported on this patch, and as the bottom is very uneven, vessels should not attempt to cross it.

Clearing marks.—Beacon Hill (Prine Daung), bearing 79° , leads 1 mile northward, and the same hill bearing 67° leads 1 mile southward of the foul ground.

Arakan River is formed by the Kaladan and Arakan Rivers, the former being the name of the main river as far as Akyab; it is the largest and most important of the rivers which rise in the Arakan hills. The port and town of Akyab are immediately within the entrance on the western side of Kaladan River.

Fakir Point, on the western side of the entrance, and nearly 10 miles southeastward of Mayu Point, is low, as is also the land within it, which is cultivated and covered with coconut groves. A flagstaff stands on Fakir Point.

Savage Island, on the eastern side of the entrance, is about 65 feet in height and 1 mile west-northwest of Hodge Point, the eastern entrance point; Passage Rock, 10 feet high, is about $\frac{1}{2}$ mile north-westward of Savage Island.

Peaked Rocks, above water, lie $\frac{1}{2}$ mile southwestward of Savage Island, and White Rocks, also above water, stretch about a mile southeastward from Peaked Rocks; between this chain of rocks and Hodge Point are flats, the western with a few feet water over it and the eastern drying 2 feet.

Light.—A cylindrical stone tower, 70 feet in height, painted white, with a red lantern and white dome, is situated on the northwestern point of Savage Island, from which is exhibited at an elevation of 110 feet above high water a fixed and flashing white light, visible 16 miles. (For details see Light List.)

Dangers.—From about 5 miles west-northwestward of Fakir Point, the edge of an extensive flat, with depths under 3 fathoms, extends in a southerly direction for a similar distance, and then forms a prong, the extreme of which is $4\frac{1}{2}$ miles south-southwest of Fakir Point; the eastern edge of this flat forms the western side of the channel to the entrance to the river. The sea breaks heavily over the eastern part of this flat during the southwest monsoon.

Fakir Reef, consisting of rocks which dry from 2 to 3 feet, extends about 700 yards south-southeastward of Fakir Point.

The only outlying danger on the eastern side of the entrance is a rock with $5\frac{1}{4}$ fathoms over it, which lies 300 yards northwestward of Passage Rock, but near the outer bar and eastward of the prong of the flat are two patches with depths of 3 fathoms over them, which lie 2.1 and 2.3 miles, respectively, south-southwestward of Savage Island Lighthouse.

Outer Bar—Depths.—The Outer Bar, which is situated between $2\frac{1}{2}$ and $4\frac{1}{2}$ miles southward of Fakir Point, has shoaled in places as much as 2 feet, but in 1906 in no place was there a less depth than 21 feet. Inside the Outer Bar the depths increase to 6 and 8 fathoms, and between Fakir Point and the shoals extending eastward of Savage Island there are from 11 to 19 fathoms, from which the water shoals to $6\frac{1}{4}$ at the outer and 4 fathoms at the inner anchorages.

Buoys.—The outer buoy, moored in a depth of 22 feet on the Outer Bar, is conical, painted black, surmounted by a staff and cage, and situated 2.2 miles south-southwest of Savage Island Lighthouse.

A conical buoy, painted black, and surmounted by a staff and cage, is moored off the south end of Fakir Reef and $\frac{1}{2}$ mile south-southeastward of Fakir Point.

Akyab Port, situated northward of Fakir Point, off the western bank of Kaladan River, and between it and the shoal water extending from Flat Island, is about 2 miles in length, with a general breadth of about $\frac{1}{2}$ mile.

Inner bar—Depths.—An inner bar, crossing the entrance from the southwest shore northward of Fakir Point to the southwest extreme of the shoal extending from Flat Island, has a least depth of 23 feet on the track recommended, and northward of it the depth gradually increases, there being $4\frac{1}{2}$ to 5 fathoms off the town and from 6 to 7 fathoms at the anchorage farther north.

Inner dangers.—Saunders Shoal, situated in mid-channel of the river, its southwest extreme being 1 mile eastward of Fakir Point, is $\frac{3}{4}$ mile in length in a northeast and opposite direction, and 300 yards in breadth; it has a least depth of $2\frac{1}{4}$ fathoms over it.

Flat Island, occupying the center of the river, its southern side being about 5 mile northeastward of Fakir Point, is low and covered with brushwood.

Flat Island Spit, which dries at low water, stretches about $2\frac{1}{4}$ miles southwestward from the southwestern side of Flat Island, with shoal ground extending for a farther distance of $1\frac{1}{2}$ miles south-southwestward of the southern extreme of the spit; it forms the eastern side of the channel opposite Akyab.

Buoys.—A conical buoy, painted red and surmounted by a staff and cage, is moored in a depth of 20 feet about 200 yards southwestward of the extreme of the shoal extending from Flat Island Spit.

Channel buoy, conical, painted red, and surmounted by a staff and cage, is moored in a depth of 22 feet about 600 yards southwestward of Flat Island Spit to mark the eastern side of the channel above Akyab.

Pilots.—Pilots, licensed by the government of Burma, are stationed at Fakir Point, and during the season when the port is much visited by vessels one will usually be found cruising outside the bar, the pilot boat being a whaler, painted white.

In the event of no pilot being available, vessels should anchor about 1 mile to the southward of the Outer Bar Buoy until one can be obtained.

Anchorage.—Temporary anchorage may be taken up, in a depth of 5 fathoms, with Savage Island Lighthouse bearing 202° ; with North and South Hummocks in line, bearing 143° ; or anywhere after passing Fakir Reef, taking care to avoid Saunders Shoal; the deepest and largest area is southeastward of Flat Island Spit, but owing to its distance from the town it is seldom used.

Merchant vessels usually anchor westward of Flat Island Spit, between the main wharf and Charugyea Creek, about 300 yards from the shore, to facilitate working cargo, but if this is not required a convenient anchorage for vessels of less than 22 feet draft is off the hospital. The deepest water for large vessels is off Charugyea Creek, within 70 yards of the shore.

Directions.—Vessels are prohibited from entering or leaving the port between sunset and sunrise.

Vessels of heavy draft coming from the westward during the southwest monsoon should steer 91° for Prine Daung, until the flagstaff on Fakir Point is in line with Savage Island Lighthouse, bearing 355° , which leads over the Outer Bar in a depth of 25 feet, but, in a vessel of deep draft, Savage Island Lighthouse bearing 348° will lead over the bar in not less than 28 feet water.

Vessels of light draft, when there is no swell, may cross the Outer Bar, in a depth of not less than 16 feet, by passing close to the outer black buoy and bringing Savage Island Lighthouse to bear 18° . After crossing the bar the pecked line on the chart should be followed, steering first about 330° until Savage Island Lighthouse bears about 91° , then altering course to about 41° and the 63° until the Fakir Point bears about 316° , when a course may be shaped between Fakir Point and Saunders Shoal for the anchorage.

There is a safe passage for boats and small craft between Savage Island and the northern end of Baronga Island, sheltered from the sea in the Southwest Monsoon.

Caution.—Entering with the flood stream, great care is necessary when in the vicinity of White Rocks, as it sets directly on to them; leaving with the ebb stream, the vessel should be kept as near these rocks as prudence will allow, to prevent being set on to the western bank.

Storm signals are shown at Akyab.

Tides.—It is high water, full and change, at Akyab at 9h. 37m.; springs rise $7\frac{1}{2}$ feet, neap $5\frac{1}{2}$ feet; neaps range 2 feet 8 inches. In the rainy season, April to October, the rise is from 2 to 3 feet more. The tides rise and fall quickly, the slack water lasting 3 hours.

Tidal streams.—The tidal streams are regular, and rapid at springs, when heavy overfalls form on the ebb between Fakir Reef and Passage Rock. The rate at springs on the Outer Bar is from three-quarters of a knot to 2 knots, but between Fakir Point and Passage Island they attain a rate of from 3 to 4 knots. During neaps the streams are very weak.

The streams set directly across Fakir Reef, and a vessel leaving the anchorage when the ebb stream is running will be set toward that reef after passing Fakir Point.

Town.—Akyab Town, the headquarters of Akyab District, ranks fourth among the towns of the province, and is situated on well-wooded, low-lying ground, in reality an island, triangular in shape, about 5 square miles in extent, and separated from the mainland by a creek which connects the Kaladan and Mayu Rivers.

The houses of the Europeans are built near the point which is the apex of the triangle and along the eastern shore of the harbor, while the native town fills the northern part of the triangle. The principal buildings are the Government Offices, the jail, the hospital, and the high school, and there are Anglican and Roman Catholic churches. In 1901 the population was 35,680. Most of the dwelling houses are built of wood or mat, with thatched roofs.

Communication.—Steamers of the British India Line run weekly to Chittagong and Calcutta, and also to Rangoon, Moulmein, and Straits Settlements; there is also telegraphic communication.

Coal and supplies.—About 4,000 tons of coal are kept in stock and between 5,000 and 6,000 tons are imported annually; coaling is carried on with lighters, of which there are about 30 holding from 40 to 60 tons, and from 200 to 400 tons could be put on board in 24 hours.

Provisions, beef, fish, and vegetables, are plentiful. Preserved provisions and marine stores are obtainable. Fresh water of fair quality is supplied, being pumped from a water boat, and a scheme is under consideration for bringing it from a reservoir to be constructed about 2 miles outside the town.

Wharves.—The main iron wharf is 660 feet in length and its T head 204 feet; it can be reached by vessels drawing 21 feet. There is also a small stone pier and several smaller wooden jetties.

Repairs.—Large repairs can be effected to hull or machinery of vessels; there are two cranes, each lifting 3 tons.

Trade.—The exports consist almost exclusively of rice, and imports from Burmese ports are gunny bags, dried fish, cotton, betel nuts, etc., but the foreign imports are insignificant. There are 11 steam-power rice mills in the town, a sawmill, and a tannery.

Quarantine.—There are special quarantine regulations at Akyab, a copy of which should be obtained from the harbor authorities.

Hospitals.—A large general hospital has 114 beds, and attached to it is a European seamen's hospital; there is also a dispensary.

Sailors' home.—There is a sailors' home.

Winds and weather.—The southwest monsoon begins early in May and lasts until the end of October. Occasionally the southwest monsoon increases in strength from a southerly direction, and is accompanied by heavy rain and sea, when caution is necessary in approaching the land.

In the northeast monsoon the wind commences at north in the morning, and hauls gradually to the southeast toward noon; it is then calm until the sea breeze sets in from west and southwest, which veers to northwest in the evening. These winds prevail with regularity from November to April.

Climate.—The town is unhealthy, being subject to regular epidemics of cholera and malarial fever. In the southwest monsoon the rainfall is very heavy, the whole country becoming almost inundated, and the rivers swollen. The winter months are very dry.

Baronga Island, southward of Arakan River entrance, is 17 miles in length north-northwest and south-southeast, $\frac{3}{4}$ mile to 2 miles in width, and generally high and thickly wooded; a hummock is near its southern end; Prine Daung, the tableland at its northern end, is 962 feet high, and conspicuous, except from the southward, where it is hidden by a mountain 1,135 feet high, which latter appears as a sharp peak when seen from the southward, but from the westward is only an inconspicuous serrated ridge.

South Hummock, a hill near the southern end of the island, is conspicuous when seen from the westward, as also is a white pagoda, standing on a low hill on the west coast of the island, $2\frac{1}{4}$ miles northward of the hummock.

A narrow ledge of rocks, most of them covered at high water, extends from the southern extreme of the island, and at its southern part is a small rock, awash, visible at high water and situated about 1,200 yards southward of the point; beyond this small rock others,

which cover and uncover, extend for a distance of about 400 yards, and there is foul ground for a further distance of about $\frac{1}{2}$ mile.

Mud Volcano Shoal, with $3\frac{1}{2}$ fathoms water over it and surrounded by depths of 15 fathoms, is situated on a bank about 200 yards in extent, with depths of from 7 to 8 fathoms over it, lying $2\frac{1}{2}$ miles eastward of South Hummock; the shoal is formed by the probably intermittent action of an active mud volcano.

Baronga Point—Mud volcano southward of.—An active mud volcano, with two summits, has appeared about $8\frac{1}{2}$ miles southward of Baronga Point; this volcano, on May 1, 1914, was about 30 feet in height and about 200 yards in extent.

Tides.—It is high water at the south end of Baronga Island about half an hour earlier than at Akyab, and low water at the same interval; the rise and fall at both places being practically the same.

Peni Kyong, or Middle Baronga, a high, thickly wooded island about $2\frac{1}{2}$ miles in length in a north-northwest and opposite direction, is eastward of Baronga Island and separated from it by Research Strait, which is about 2 miles in width at its narrowest part; it is deep at its southern, but blocked by shoals at its northern end, where it joins Akyab Port.

A chain of small islands and rocks, of which Square Rock (33 feet), Painaisa Island (190 feet), Barn Island, reddish colored (100 feet), Conspicuous Rock (30 feet), and South Rocks, white and flat (12 feet high) are the principal, lies on a narrow ridge; extending about 6 miles in a south-southeast direction from the south point of Peni Kyong Island, and a mile from the extreme of the ridge, is Bingham Rock, which dries 3 feet, with depths of from 11 to 12 fathoms between; Painaisa Island and Conspicuous Rock are easily recognized.

Angrei Kyong, or Eastern Baronga, has a line of direction similar to the two outer islands, but is inconspicuous from seaward. Detached rocks and shoals extend about $5\frac{1}{2}$ miles southeastward of its south point, the outermost drying 8 feet.

Communication.—The small steamers which afford communication by the inshore channels usually pass through Mraboong River, calling at Myebon, a town of some importance, but a navigable channel eastward of Angrei Kyong is also used by those running between Akyab and Kyaukpyu.

Small steamers also ply in several of the creeks to the eastward of Hunter and Combermere Bays.

Kyaukpyu District.—The northern limit of Kyaukpyu District is about 5 miles northward of Myebon, the coastline extending about 65 miles southeastward and including Ramree and Cheduba Islands; the only port is Kyaukpyu.

Hunter Bay, eastward of Angrei Kyong, is a deceptive and un-navigable bay, intersected by several shallow creeks.

Keuain Kaun Taung, 1,610 feet high and situated near the southwest side of an unnamed island, eastward of Hunter Bay, is a conspicuous peak which, in clear weather, may be visible from a distance of 45 miles when approaching from the southward.

Kyong Siya (Elizabeth Island), 860 feet high, is bold, but has no definite summit; the northern and highest part of the island is the most conspicuous.

Seppings Island, which has a conspicuous, conical-shaped summit, 840 feet high, near its northwest side, sloping gradually to the southward and eastward, is a conspicuous mark when approaching **Kyaukpyu**.

Combermere Bay is a considerable inlet into which flow numerous small straits and rivers, the most important being the An River, which is navigable by boats as far as the town of the same name, situated on the left bank, 23 miles from its mouth. There are depths of 5 to 12 fathoms in Combermere Bay, but many islands, shoals, and groups of rocks are scattered over it.

The navigation of the bay, for which the chart is the best guide, is intricate and dangerous, and it is rarely entered by European ships, the trade of the district being carried on by native craft.

Anchorage.—There is temporary open anchorage in from 7 to 9 fathoms water, over mud and good holding ground, off the entrance to Combermere Bay.

Reef Island, the northwestern of the islands at **Kyaukpyu** entrance, is about 800 yards in length in a northeast and southwest direction, 300 yards in width, and 190 feet high; it is sparsely wooded, of reddish earth, and not conspicuous from seaward, as it is blended with the higher wooded peaks of the islands eastward of it. It is surrounded by a shore reef which extends 300 yards from its southwest and northeast sides, and reefs with rocks from 3 to 5 feet high on them extend for 2 miles northwestward of the island; as the locality has not been closely examined the island should not be approached within a distance of 3 miles in that direction.

Wood Harbor.—**Narkumbau Island**, $\frac{3}{4}$ mile eastward of **Reef Island**, is about 1,400 yards in length in a northwest and southeast direction, $\frac{1}{2}$ mile in width, and 380 feet high, and forms the northern side of the entrance to Wood Harbor; **Catherine Bluff**, the northwest end of **Tangaro Island**, being the southern entrance point. The harbor is nearly 1 mile in extent, has from 19 to 27 fathoms through its center, shoaling to its northern and southern sides.

Anchorage.—Wood Harbor affords anchorage in depths of from 5 to 15 fathoms, over mud, with the eastern extreme of **Catherine Bluff** bearing 274° , and a gap in the hills on **Tangaro Island** about 246° .

Directions.—The entrance to this harbor, between the bluff extremes of Narkumbau and Tangaro Islands, should be approached with the north end of Catherine Bluff bearing about 94° to avoid some irregular soundings extending northwestward of Crooked Island.

Tidal streams.—The tidal streams at springs run through Wood Harbor Entrance at a rate of about 3 knots.

Kyaukpyu Harbor (meaning White Stone, probably derived from the white pebbly beach) is a well-sheltered anchorage, formed by a chain consisting of Crooked, Quoin, Tangaro, and Laws Islands on the north, and the north end of Ramree Island on the south; the former extend a considerable distance northeastward into Combermere Bay, with numerous small straits and boat passages between them.

The harbor is open only to the west-northwestward, and the anchorage is well protected by Dalhousie Fort Point, the northern extreme of Ramree Island, from that direction. The eastern portion of the harbor narrows to about $1\frac{1}{2}$ miles in width 3 miles eastward of the anchorage, when it abruptly turns southeastward, forming Fletcher Hayes Straits, a broad, safe, and convenient passage for boats, 18 miles in length, and communicating by a smaller creek with Ramree Harbor.

Pagoda Rock, about 2 miles south-southwestward of Catherine Bluff and on the northern side of Kyaukpyu Harbor Entrance, is small, 85 feet high, of conical form, with two sharp-pointed summits close together, and is steep-to, but depths under 3 fathoms commence about 100 yards eastward of it. Its seaward side is occasionally whitewashed and it is an excellent mark. The edible-nest swift is found here.

Crooked Island, eastward of Pagoda Rock, is low, and its western side is skirted by reefs and detached rocks, with depths under 3 fathoms extending nearly $1\frac{1}{2}$ miles; there is foul ground, with a rock 4 feet high and breakers nearly 1,200 yards northwestward of it. A wooded ridge, about 60 feet high, stretches from the middle of the island for about 1,400 yards southeastward, and on its northern end is a small white pagoda. The eastern and southern parts of the island are low and swampy.

Squadron Rocks, low, narrow, and rocky, with a few shrubs and a solitary tree, lie about 300 yards westward of and parallel to the southern part of Crooked Island. A rock awash at low water lies 600 yards south-southeastward of the southern of these rocks, which is 15 feet high.

Quoin Island, triangular in shape, thickly wooded, and 260 feet high, lies close southeastward of Crooked Island, and from sea-

ward appears wedge-shaped, the northwestern end being the highest part.

A ledge extends nearly 400 yards southward of its south point, from the extremity of which the water abruptly deepens to upward of 40 fathoms. The space between two prongs, which form the southeast part of the island, is occupied by a flat, which covers at half tide.

North Shoal, a small rocky patch of which the western part is awash at low water, spring tides, lies 1.4 miles westward of the southern point of Quoin Island.

Buoy.—A can buoy, painted black, is moored about 200 yards southward of North Shoal.

Tangaro Island, about $6\frac{1}{2}$ miles in length, is narrow, thickly wooded, of irregular shape, and 50 to 465 feet high; it lies eastward of the above islands and with them forms the northern side of Kyaukpyu Harbor. The space between Quoin Island and Barker Point, the southeast point of Tangaro Island, is filled with a shallow flat, on a great part of which the depths are less than 1 fathom.

Laws Island, the center of which is about $1\frac{1}{4}$ miles southward of Barker Point, is about 1 mile in extent, 590 feet high, covered with foliage, and has a conspicuous tree on its summit used as a leading mark between the shoals into Kyaukpyu Harbor.

Southern side.—**Saddle Island**, on the southern side of Kyaukpyu entrance, is $\frac{3}{4}$ mile in length in a north-and-south direction, 300 yards in width, and has two rounded summits sparsely covered with trees near its north end, the northern being 156 feet high; as numerous sunken reefs surround this island, it should not be closely approached.

Shoal water, with several sunken rocks, extends nearly $1\frac{1}{4}$ miles northward of Saddle Island, and two small rocks, 6 and 5 feet high, lie 800 and 1,400 yards, respectively, from its northern end.

Foul ground, with the sea breaking on its outer edge, extends nearly $1\frac{1}{2}$ miles westward of Saddle Island, and from its southern extreme a reef of rocks above water stretches a mile southward to the northern side of Bowman Passage.

Dacey Shoal, on which the sea sometimes breaks heavily, is the extreme of the rocks stretching northward from Saddle Island.

Buoy.—A red conical buoy, with staff and ball, is moored about $\frac{1}{2}$ mile westward of northern end of Dacey Shoal.

Giles Bank, with a depth of $4\frac{3}{4}$ fathoms over it, is situated in the middle of the harbor entrance, $2\frac{1}{4}$ miles northward of the north end of Saddle Island.

Cap Islet, lying $1\frac{1}{2}$ miles southeastward of the southern end of Saddle Island, is 148 feet high, and conspicuous; Knot Islet, lying 1.7 miles eastward of the same end of Saddle Island, is 6 feet high,

with a few shrubs on it; both islets are surrounded by reefs. The channel between Saddle and Ramree Islands is not safe, owing to the numerous reefs and rocky patches in it.

Ramree Island.—The northern part of Ramree Island is thickly wooded, and forms the southern side of Kyaukpyu Harbor. The coast from Adams Point, which is abreast Cap Islet, trends northward and eastward in a succession of sandy beaches and rocky points, with foul ground and shoal water off it, for a distance of about 3 miles to Georgina Point, and thence 2 miles to Dalhousie Fort Point.

Mount Peter, $\frac{1}{2}$ mile eastward of Adams Point, is 333 feet high, with a conspicuous tree on the ridge to the northward, and the northwest end of Ladies Ridge, which stretches southeastward for about $\frac{3}{4}$ mile, and is situated $\frac{1}{2}$ mile southward of Georgina Point, has on its summit, 218 feet high, some trees, which appear conspicuously from the westward.

Shoal.—A patch on which the depth is $2\frac{1}{2}$ fathoms, surrounded by depths of from 4 to 5 fathoms, lies 1.1 miles west-northwest of Georgina Point.

Bombay Shoal, a bank of rocky ground, $\frac{1}{2}$ mile northward of Georgina Point, has depths of from $1\frac{3}{4}$ to $2\frac{3}{4}$ fathoms over it, and is generally marked by overfalls. About $\frac{1}{4}$ mile eastward of Bombay Shoal is the western end of a patch with depths under 5 fathoms, on which there is a 3-fathom spot.

Reliance Shoal, a small patch with $1\frac{1}{2}$ fathoms water over it and depths of 5 fathoms and less for about 200 yards southward of it, lies $1\frac{1}{4}$ miles northeastward of Georgina Point.

Buoy.—A conical buoy, painted red and surmounted by a basket topmark, is moored 300 yards northward of Reliance Shoal.

Dalhousie Fort Point, well marked by high trees on it, is low and sandy, with a large clump of palm trees and the remains of a fort on it; 250 yards southeastward of the point is an iron pier. The sea is rapidly encroaching on the land westward of Dalhousie Fort Point.

From Dalhousie Fort Point a sandy beach, with a foreshore of mud, which dries out from 300 to 400 yards at low water, trends southeastward for $1\frac{3}{4}$ miles to the mouth of Ungyaung Creek.

The Terribles, about 9 miles westward of Saddle Island, are three groups of rocks above water, extending, with the surrounding sunken rocks, nearly 8 miles in a north-northeast and south-southwest direction.

North Terrible, the largest rock of the group, is 12 feet high, and sunken rocks extend 2 miles northward from it and a similar distance in a west-southwest direction.

Mid Terrible, $1\frac{1}{4}$ miles south-southwestward of North Terrible, is 14 feet high.

South Terrible, 12 feet high and consisting of several low rocks, is 4 miles south-southwest of North Terrible; breakers extend nearly 2 miles southward of it, South Rock, which dries 6 feet, being near the south extreme. There is a large reef between Mid Terrible and South Terrible.

Mud Volcano Shoal.—A shoal with $4\frac{1}{2}$ fathoms water over it, formed by an active mud volcano, and situated 3 miles west-southwestward of Mid Terrible, was found during the course of the survey in 1908; its position when close to is pointed out by discolored water, but as this shoal area may have increased, or other shoals may exist, this locality should be avoided. Also in September, 1909, a volcanic upheaval took place about 6 miles southeastward of Mid Terrible, in the southern approach to the channels inside those islands, rendering great caution necessary.

Caution.—The Terribles should not be approached nearer than a depth of 20 fathoms to the southward, or 24 fathoms to the westward, unless bound for Kyaukpyu Harbor or Cheduba Strait; and a wide berth should be given them at night.

Irrawaddy Rock, which dries 2 feet, is situated at the southwest edge of a shoal 1 mile in length, in a northeast and southwest direction within the 5-fathom contour line surrounding it; the rock lies 4 miles westward of the summit of Saddle Island; and is not easily seen in a smooth sea.

Directions.—The entrance to Kyaukpyu Harbor is well marked by natural objects, and the principal dangers near the track in are buoyed, but it should be remembered that at the entrance the flood stream sets to the northward and the ebb to the southward, often with considerable velocity.

From the northwestward or westward approach with Pagoda Rock bearing 91° until Saddle Island bears 135° , and then steer to enter the harbor with the tree on the summit of Laws Island bearing 98° , which passes about 800 yards southward of Giles Bank and North Shoal Black Buoy; 1,400 yards northward of Dicey Shoal and 400 yards northward of the red buoy marking Reliance Shoal, after passing which, round Dalhousie Fort Point to the anchorage.

Pagoda Rock should not be brought to bear northward of 90° until North Terrible bears westward of 212°

From the southward, to pass eastward of the Terribles, Nondogi Island Summit, which is high, conspicuous, and wedge-shaped, should be kept in line with the northern point of Satellite Island, bearing about 29° until South Terrible bears 316° , when alter course to 1° to pass about 2 miles westward of Irrawaddy Rock, until Nondogi Summit is well open westward of Satellite Island, about 40° , which course may be steered until the single tree on Laws Island bears 98° .

The passage inside the Terribles should not be taken in a sailing vessel.

A vessel with local knowledge might pass through Dickenson Channel, between Irrawaddy Rock and the dangers westward of Saddle Island, by keeping Seppings Peak in line with the center of Satellite Island, bearing 33° .

NOTE.—The positions of the buoys at Kyaukpyu can not be relied on.

Anchorage.—The best anchorage is southeastward of Dalhousie Fort Point, in depths of from 9 to 10 fathoms, over mud, with the pier bearing between 271° and 288° , distant $\frac{1}{2}$ mile. There are strong eddies at this anchorage at springs, but the tidal streams are weak at neaps.

There is also anchorage in Southampton Road, eastward of Dicey Shoal, but the holding ground, consisting of broken shells and stones, is not good.

Tides.—It is high water, full and change, at Kyaukpyu Pier at 9h. 38m.; springs rise $10\frac{1}{2}$ feet, neaps rise $6\frac{1}{2}$ feet, neaps range 2 feet 6 inches.

Tidal streams.—The rate of the tidal stream varies from 1 knot to 3 knots an hour; outside Saddle Island the flood sets northward, the ebb southward, frequently with considerable velocity, but the streams are very weak at neaps. Among the islands the streams follow the direction of the channels.

Currents.—In the offing the drift of the northeast and southwest monsoons will be experienced.

Kyaukpyu Town, the headquarters of the district of the same name, is built close to the seashore, on a sandy plain, in the northern angle of Ramree Island, and bounded on the southwest by a low range of sandstone hills; the name, signifying white stone, is said to be derived from the white pebbly beach fronting it. In 1901 the population was 3,145.

Communication.—British India Steam Navigation Co.'s vessels to Calcutta and Rangoon call weekly. Small steam vessels ply through the Wembaik Creek to Ramree, Taungup, and Cheduba, and those belonging to the Arakan Co. have a weekly service between Kyaukpyu and Akyab, proceeding through the creeks, and calling at any important villages; these vessels also run to Ramree and Sandoway. Telegrams are sent to Akyab, Rangoon, and Taungup for transmission.

From Kyaukpyu southward to Sandoway River the coast is indented by numerous creeks, navigable by large country boats which go almost the whole way from Kyaukpyu to Taungup by backwater, the passage taking about four days. The boats are not built for sea work, and the natives are unable to land from a boat in the surf.

Supplies of any kind are scarce; a few fowls, ducks, and vegetables, and occasionally beef of inferior quality, may be procured.

Good water is obtainable from wells.

Trade.—The exports go entirely to Burmese ports, from which three-fourths of the imports come, and the remainder from Calcutta.

Ramree Island is 44 miles in length in a northwest and southeast direction, and nearly 19 miles in greatest breadth; its highest summit, situated near the southwest side, is 1,130 feet.

West coast.—The west coast of Ramree from Adams Point trends southwestward 2 miles to West Point, whence it turns south-southeastward to Thames Point, and is tolerably straight, of rocky appearance, with a few detached rocks above water near it. This coast rises somewhat steeply to a range of high hills, the most prominent peaks of which are Outer Peak, North Paps Hill, and Tree Summit.

Outer Peak, at the northern end of a range of hills close to the coast, is 420 feet high and comparatively bare, although the range to the southward, which rises to 540 feet, is thickly wooded.

North Paps, nearly 5 miles southward of Outer Peak, and the most remarkable hill on this stretch of coast, is 455 feet high, and has a conspicuous bungalow on the coast at its foot, near Minbyin Village.

Brown Hill, nearly 5 miles southward of North Paps, is so named on account of its color, as compared with other hills in the vicinity, and southeastward of it is Tree Summit, 420 feet high, and easily recognized by a tall tree on it. Black Hill, 410 feet, and Pimple Hill, 465 feet high, are both back hills, named from their appearance as seen from seaward; they are unmistakable when not obscured by the front range.

Caution.—As there are several off-lying dangers along this coast it should be given a wide berth.

Research Rock is a sunken reef with a depth of less than 1 fathom in its center and extending in patches in a northwest and southeast direction to a total length of $1\frac{1}{4}$ miles; it lies $2\frac{1}{4}$ miles south-southwestward of West Point.

Thames Point, 15 miles south-southeastward of West Point, is low, and has some tall trees on it. The bight formed between Thames and Rocky Points has depths of 4 fathoms at the distance of $2\frac{1}{2}$ miles from the shore.

Cheduba Strait, between Ramree and Cheduba Islands, is 5 to 6 miles wide, and has numerous shoals in it; the navigable channel has a depth of $3\frac{1}{2}$ fathoms at low water springs.

Rocky Point, 10 miles south-southeastward of Thames Point and the northwestern entrance point of Cheduba Strait, is low, but a table mountain east-northeastward of it is conspicuous from the northwestward.

Beacon.—A pole beacon 30 feet high and surmounted by a basket marks Rocky Point.

Coast.—From Rocky Point to a point about $\frac{1}{2}$ miles southeastward the coast forms a deep bight, at the head of which is Dark Hill, 268 feet high; Helby Hummock, small, wooded, and showing up well from the northwestward, is nearly 1 mile south of Dark Hill.

From the point on the southeast side of the bight the coast trends in an east-southeast direction for 5 miles to where Button Islet, 115 feet high, lies about $\frac{1}{4}$ mile off the land; this islet is not noticeable from the westward.

Beacon.—A pole beacon 30 feet high and painted white stands on the unnamed point above mentioned.

Coast.—From Button Islet the coast trends $8\frac{1}{2}$ miles in a southeast direction to the southern point of Ramree Island; the highest summit of the island, 1,130 feet high, is 1.7 miles eastward of Button Islet.

Shoal water extends off the south coast of Ramree Island for distances of about $1\frac{1}{2}$ miles southward of Rocky Point to $\frac{1}{4}$ mile off Button Islet, whence to the southern point of Ramree Island it fringes the coast at distances of from 500 to 1,400 yards and has several rocks on it.

Buoy.—A conical buoy, painted red, is moored on the edge of the shoal ground about 3 miles southeastward of Rocky Point.

Shoals.—A patch with a depth of 3 fathoms over it lies 3 miles south-southwest of Rocky Point, and is the westernmost patch of a line of shoals trending east-southeastward for nearly 5 miles; the least water on these patches is $1\frac{1}{2}$ fathoms.

These shoals narrow both the northern and southern channels of the strait to a width of about $\frac{1}{2}$ mile.

Cheduba Island, situated southward of Ramree Island, is 16 miles long in a north-northwest and opposite direction, and triangular in shape, its northern coast having an east and west direction; it is well wooded, with a considerable amount of undulating country, and some hills rise to a height of nearly 900 feet. Its northern coast is low, the western and southern coasts are high, and the eastern coast is flat.

Center Peak, 7 miles southward of Searle Point, the north extreme of the island, is 819 feet high and conspicuous. Pagoda Peak, 725 feet high, and 2 miles farther south, has two small pagodas with a single tree between them on its summit. Palangutaung, or South Peak, $\frac{3}{4}$ mile from its southern coast, rises to a height of 885 feet. The greater part of the island is cultivated and covered with foliage.

An active mud volcano, which discharges inflammable gas, exists a short distance northwestward of Palangutaung; an eruption from it was seen in 1884. There is another near the northwest point.

Population.—In 1901 the population was 26,899.

North coast.—From the northwestern point of Cheduba Island, which is low and has an extinct mud volcano upon it, the coast trends east-northeastward 8 miles to Searle Point and thence in a slight sweep east-southeastward for a similar distance to Sandy Point, which is low.

Shoal water extends off all the north coast, and westward of Searle Point it stretches for $10\frac{1}{2}$ miles in a westerly direction, with Beacon Islet near its extreme and rocks and shoals between, and then in a southeast direction toward the northwest point of the island, forming a triangular area of foul ground, covered with large bowlders, some of which are above water.

Anchorage.—If desiring to anchor in this vicinity there is excellent holding ground $1\frac{1}{2}$ miles 34° from Beacon Islet or off Searle Point, north of the island.

Tides.—It is high water, full and change, at Searle Point at 9h. 15m.; springs rise 10 feet, neaps 7 feet.

Beacon Islet, 800 yards long in an east and west direction, 30 feet high, and composed of stones, lies $9\frac{1}{2}$ miles westward of Searle Point. A rock, having three heads close together, awash at high water, lies 1,600 yards west-northwestward of Beacon Islet, and is the outer danger.

Light.—On Beacon Islet is located an iron tower, painted red, with one white band, from which is exhibited at an elevation of 122 feet above high water a group flashing white light, visible 17 miles. (For details see Light List.)

Beacon.—A small stone beacon, 17 feet high and painted white, stands on the highest part of Beacon Islet.

Rocks.—A rock with a depth of 4 fathoms over it, which breaks in heavy weather, lies $7\frac{1}{2}$ miles northwestward, and another with 5 fathoms water over it, also breaking in heavy weather, is situated $5\frac{1}{2}$ miles in the same direction from Beacon Islet Lighthouse.

Mud Volcano Shoal.—As the result of an eruption of a mud volcano in 1906, an island was thrown up which, in 1907, was 19 feet above high water; it has now been completely washed away, but a shoal, with a depth of $2\frac{1}{4}$ fathoms over it, which breaks, and is the least water on a bank 1,400 yards in length in a north and south direction and $\frac{1}{2}$ mile in width, within the 5-fathom contour line, remains near its position, 4.8 miles northwestward of Beacon Islet Lighthouse. Mariners should avoid the locality of the above shoals.

Henry Rocks is a group of rocks above and below water, one being a pinnacle 17 feet high, lying on a reef $1\frac{1}{2}$ miles in length in a northeast and southwest direction, with two rocks, 4 feet high, near its southwest extreme, which are 3 miles west-southwestward of the northwest point of Cheduba Island.

Southwest coast.—The southwest coast of Cheduba Island is bold and trends in a southeast direction for 15 miles, faced by numerous detached rocks, both above water and sunken; native craft, with local knowledge, frequent it during the northwest monsoon for rice. West Hill, 695 feet high, and wooded, is nearly 7 miles southeastward of the northwest point of the island.

The only indentation on this side of Cheduba Island is at its southwestern end, immediately westward of Palangutaung, where Pyramid Bay, so named from Pyramid Rock, a pinnacle 208 feet high, lying off it, affords good anchorage to native craft during the northeast monsoon; south of Pyramid Rock is a reef that extends off the south end of the island for about 2 miles.

The outer rock on this coast is awash at low water and situated $1\frac{1}{2}$ miles off the land west-southwest of West Hummock, which is westward of West Hill.

Depths offshore.—The 10-fathom contour line, which is $2\frac{1}{2}$ miles westward of Beacon Islet Lighthouse, passes close westward of the two 4-foot high rocks, and then gradually closes the southwest coast of Cheduba Island, from which it is generally distant about 1 mile.

Tidal streams.—The tidal streams on the southwestern side of Cheduba Island follow the general trend of the land, but there is a considerable indraft between Cheduba and Flatt Islands. The northeast monsoon, though not affecting the regularity of the land and sea breezes, appears to cause a set to the southward.

East coast.—The east coast of Cheduba Island, trending southward from Sandy Point, is low and thickly wooded for 8 miles, when it becomes high. Cheduba Creek, leading to Cheduba Town, is 2 miles southward of Sandy Point, and a pagoda, situated about 1,200 yards northwestward of the entrance, which is newly whitewashed every autumn, is at that time conspicuous.

The shallow ground extending from the east side of Cheduba Island is prolonged in a southeast direction for upward of 7 miles from the southeastern extremity of the island, and has three islands and several rocks on it.

Cheduba Town is about $\frac{3}{4}$ mile within Cheduba Creek, and in 1901 had a population of 1,540. The produce of the island, which is chiefly rice and tobacco, is taken from the town by native craft to Kyaukpyu and Akyab for export.

Supplies.—Cattle, poultry, fruit, and wood can be obtained at reasonable prices, but water is scarce during the dry season.

Tokwekwong or Round Island, $3\frac{1}{2}$ miles off the east coast of Cheduba Island and $9\frac{1}{2}$ miles southward of Sandy Point, is 1 mile long, with an even rounded summit, 290 feet high.

Bank.—The edge of the bank, with depths under 3 fathoms, which is $1\frac{1}{2}$ miles eastward of Sandy Point, has a south-southeast direction,

increasing its distance from the east coast of Cheduba Island, and passes about $\frac{1}{2}$ mile eastward of Tokwekwong Island.

Middle Ground, a bank with depths of $2\frac{1}{4}$ to 3 fathoms over it, occupying about two-thirds of the channel on the eastern side between Sandy Point and the southern point of Ramree Island, extends about 7 miles in an east and west direction, and 6 miles north and south.

Between the western side of the bank and the edge of that extending from Sandy Point the channel is a mile in width, with a depth of $3\frac{1}{2}$ fathoms, and between the eastern side of Middle Bank and the western side of the south point of Ramree Island, the channel has a width of 600 yards, with a least depth of $3\frac{1}{4}$ fathoms.

Flatt Island, the northern point of which is nearly 3 miles south-southwestward of Tokwekwong Island, is 4 miles in length in a north and south direction, and generally low, but rises in the center to a height of 105 feet.

Hill Island, $\frac{3}{4}$ mile southward of Flatt Island, is 80 feet high, and from its south end foul ground, on which is South Rock, 8 feet high, lying $\frac{1}{2}$ mile southward of the island, extends for nearly 1 mile in a south-southwest direction, and is steep-to.

The channel between Flatt Island and Cheduba is foul, and numerous reefs extend between and among Tokwekwong, Flatt, and Hill Islands. The 3-fathoms contour line of the bank which fronts Sandy Point passes close eastward of Tokwekwong, and is $2\frac{1}{2}$ miles eastward of the northern part of Flatt Island. Hill Island should not be approached on its southern and western sides nearer than $1\frac{1}{2}$ miles.

Volcanic eruption.—A submarine volcanic eruption occurred in January, 1912, about 3 miles southwestward of the north extreme of Flatt Island.

Northwest entrance—Depths.—Following the track recommended, shown by a pecked line on the chart, the depth at the entrance, 5 miles westward of Rocky Point, should be $4\frac{1}{2}$ fathoms, deepening to 5 fathoms, which depth may continue to the turning point in the channel, but the track passes close to a $4\frac{1}{2}$ -fathom patch south-eastward of the red buoy.

On the course to the southward, between the bank off the east coast of Cheduba and Middle Ground, the least depth should be $3\frac{1}{2}$ fathoms.

Sandy Point—Mud volcano shoal.—A mud volcano shoal, with a depth of 9 feet, is situated 2 miles north-northeastward of this point, and 400 yards westward of the track recommended.

Vessels should use great caution when in this vicinity.

Directions.—Approaching Cheduba Strait from the northwestward, Cheduba Hills will be seen to the southeastward; Centre Peak

being the most conspicuous and isolated, with Pagoda Peak immediately westward of it. The high hills of Ramree Island, on the north side of the strait, are farther eastward, and fall somewhat abruptly, their summit being marked by a slight hump.

Helby Hummock, in the same direction, with Dark Hill, a moderate-sized wooded hill, northward of it, are both over the low ground of Rocky Point.

From a position about 5 miles westward of Rocky Point, with the highest summit of Ramree Hills bearing 102° , and Centre Peak, steer about 109° on the track recommended, marked by a pecked line on the chart, toward the dome-shaped hill, 285 feet high, which marks the southern extreme of the range, and is close to the coast $4\frac{1}{2}$ miles northwestward of the southern point of Ramree Island, and pass about $\frac{1}{2}$ mile southward of the red buoy marking the edge of the bank off the southern coast of Ramree Island, about 3 miles southeastward of Rocky Point, but which must not be depended on, as it is liable to be washed away.

Continue this course with the dome-shaped hill ahead until Bare Hill, a blunt conical hill to the northward, is open westward of Dark Hill, the wooded hill behind Helby Hummock, bearing 338° , which mark on astern, and following the pecked line, steering 158° , leads southward in the channel between the shoal water off Sandy Point and Middle Ground into Ramree Road.

As the edge of the bank on Cheduba Island side is very steep in places, preference should be given in this latter channel to the Middle Ground side, that shoal being cleared when Tokwekwong Island bears 203° .

From the southward.—From a position with Tokwekwong Island bearing 270° , distant $1\frac{1}{2}$ miles, steer 338° , when Bare Hill, the blunt conical hill, open westward of Dark Hill, the leading mark between Middle Ground and the shoals off Cheduba Island, will be just visible above the horizon and shows as a double hill. When the dome-shaped hill bears 109° , steer 289° , keeping it astern, and passing southward of the red buoy, follow the track recommended until about 5 miles westward of Rocky Point.

Ramree Harbor.—Sagu Island is separated from the south point of Ramree Island by The Gates, a channel $1\frac{1}{4}$ miles in width, and with depths of from 18 to 36 fathoms, which is the main entrance into Ramree Harbor. From this entrance the harbor trends northward for 18 miles, with an average breadth of $3\frac{1}{2}$ miles, forming an arm of water separating Ramree Island from the low, swampy islands adjacent to the mainland. There is excellent anchorage all over Ramree Harbor, but it contains several rocks and shoals.

The entrance to the harbor eastward of Sagu Island is filled with mud and sand banks, through which there are some narrow channels, only suitable for fishing boats.

Sagu Island, nearly 4 miles in length in a northwest and southeast direction, and $2\frac{1}{2}$ miles in breadth, has Channel Clump, a conspicuous isolated clump of trees, 195 feet high, on its northern part, which is a mark for The Gates from the southwestward.

Dragon Shoal, of varying depth, and with rocks and shoal patches throughout its length, trends for $5\frac{1}{4}$ miles in a north-northeast direction from the northern point of Sagu Island. White Rock, 3 feet high and one of a group above water, lies about a mile from its northern end.

On the western side of the channel some rocky patches with depths of from $2\frac{3}{4}$ to $3\frac{1}{4}$ fathoms over them, extend in an easterly direction for a mile from a point of Ramree Island, $1\frac{3}{8}$ miles northeastward of its south point, leaving a channel about $\frac{3}{4}$ mile wide, with depths of from $5\frac{1}{4}$ to 9 fathoms between them and the western edge of Dragon Shoal. There are numerous fishing stakes in this part of the channel.

Flat Reef, a patch of rock covered at high water and steep-to, lies midway between the northern end of Dragon Shoal and the coast of Ramree Island to the northwest. It may be passed on either side, but the channel between it and the north end of Dragon Shoal is 800 yards in width, and that generally used.

Beacon.—A beacon consisting of a mound of stone of white color, about 15 feet in height, is on the southern end of Flat Reef, marking it when covered at high water.

Kyang-yaung Point, 100 feet high, is a bluff on the western shore, 8 miles north-northwest of the south point of Ramree Island, with a low islet $\frac{1}{2}$ mile southeastward of it, which is steep-to on its eastern side; a shoal, nearly awash at low-water spring tides, lies 700 yards northeastward of the northern part of the point.

Oyster Reef, which covers at high-water spring tides, lies 3 miles northward of Kyang-yaung Point, and Cutters Rock is a mile farther in the same direction. For 5 miles northward of Cutters Rock there are depths of $3\frac{1}{4}$ to 4 fathoms, but the channel is much narrowed by mudbanks.

Ramree River entrance, 8 miles northward of Kyang-yaung Point, admits vessels of 9 feet draft, which can navigate the river to within $1\frac{1}{2}$ miles of Ramree Town at ordinary high water.

Ramree Town, about 5 miles up Ramree River, had a population of 2,540 in 1901, and carries on a small trade with Chittagong, Sandoway, and Bassein.

Wembaik Creek, which joins the northwestern part of the harbor and the inner part of Kyaukpyu, can be navigated by steamers of from 6 to 8 feet draft.

Magyigyun, an island $2\frac{1}{4}$ miles in length in a northwest and southeast direction, lies 2 miles southward of Sagu Island; it is 270 feet high, whalebacked, and stands in the center of a shoal bank, 5 miles long.

Tangagyo chaung, a small islet, lies about $\frac{1}{2}$ mile off its west point, and the western end of the shoal bank is $1\frac{1}{4}$ miles westward of the islet. Nyaungbinchaung Islet lies $\frac{1}{2}$ mile southwestward of a point on that side of the center of Magyigyun Island, and marks the southwestern edge of the shoal bank.

Osprey Rocks, 8 feet high, form a group lying on a shoal, $1\frac{1}{4}$ miles in length in a north-northeast and opposite direction, and $\frac{1}{2}$ mile in width, situated 5 miles southeastward of the southeast point of Magyigyun.

Pandaw Rocks, a group of low rocks, the northwesternmost 2 feet high, lie on a shoal $\frac{3}{4}$ mile in extent about $3\frac{1}{2}$ miles east-northeast of Osprey Rocks.

Gungasager Rocks, 3 feet high, lie 10 miles southeastward of the southeast point of Magyigyun, and are on the southwest steep-to end of a shoal, which, within the 5-fathom contour line, is $1\frac{1}{4}$ miles in length in the northeast and opposite direction; a patch of foul ground, $\frac{1}{2}$ mile in length in an east and west direction and with depths of from $3\frac{1}{4}$ to $4\frac{1}{4}$ fathoms, lies $1\frac{1}{4}$ miles northward of Gungasager Rocks.

Anchorage in Ramree Harbor may be obtained in depths of from $3\frac{1}{2}$ to 4 fathoms, with the entrance to Ramree River bearing about 276° .

Directions.—Approaching Ramree Harbor from the southeastward, pass southwestward of Gungasager and Osprey Rocks at distances of about 2 and $2\frac{1}{2}$ miles, respectively, and from $2\frac{1}{2}$ to 4 miles westward of Magyigyun Island, whence steer to the northward for the entrance to the Gates, avoiding the fishing stakes, which are charted, in this channel, and proceed through the Gates in mid-channel, steering about 54° .

When the north point of Sagu Island bears 150° , alter course, passing eastward of the shoals extending into the harbor from the coast of Ramree Island, observing that numerous fishing stakes are charted here, and not bringing the north point of Sagu to bear westward of 183° until about a mile from Flat Reef Beacon, when alter course to pass 400 yards southeastward of Flat Reef.

Having passed Flat Reef steer to pass $\frac{1}{2}$ mile eastward of Low Islet off Kyang-yaung Point, when a 344° course leads eastward of

Oyster Reef and Cutters Rock, whence keep about $\frac{3}{4}$ mile off the western shore to the anchorage off Ramree River entrance.

Caution is necessary in the vicinity of Flat Reef, Oyster Reef, and Cutters Rock.

Tides.—It is high water, full and change, at Sagu Island at 9h. 23m.; springs rise 11 feet, neaps rise 8 feet.

At Flatt Island it is high water at 9h. 7m.; springs rise 9 feet, neaps rise $6\frac{1}{2}$ feet; neaps range $3\frac{1}{2}$ feet.

At the south entrance to Wembaik Creek it is high water at 9h. 50m.; springs rise $12\frac{1}{2}$ feet, neaps rise 9 feet.

Tidal streams.—The flood stream sets northward and the ebb southward at springs, with a rate in the harbor of 3 knots and in the Gates of 3 to 4 knots, in the direction of the channel.

Kayaing Creek entrance is about 11 miles southeastward of the northern point of Sagu Island; Taungup River, on which is the village of that name, flows into the narrow creek, and within 1 mile of Taungup the river is about 50 feet wide and barely navigable by a steam launch.

Coast.—From Kayaing Creek entrance the coast trends south-southeastward for about $13\frac{1}{2}$ miles to the southwest point of Singaung Island, on the northern side of Sandoway River entrance. This land forms long, low islands, rising about 25 miles within them to the mountains of Kyaukpyu Range.

Sandoway District commences on the mainland side northward of Ramree Harbor, and the coastline extends southward for about 115 miles; Sandoway and Gwa are the two ports.

Heywood Channel.—About 4 miles southeastward of Flatt and Hill Islands, is a line of reefs and rocks, about $5\frac{1}{2}$ miles in length in a north-northeast and south-southwest direction, which, with West Shoal, detached, and lying about $2\frac{1}{2}$ miles southwestward from the eastern side of Heywood Channel, the western side being the reefs and shoals extending from Flatt and Hill Islands; this channel, about $2\frac{1}{2}$ miles in width at its northern end, reduced to about $\frac{3}{4}$ mile between the 5-fathom contour lines, has depths of from $5\frac{1}{2}$ to 12 fathoms, but it is not recommended.

West Shoal, about 5 miles south-southeast of Hill Island, is $\frac{1}{2}$ mile across, and does not always break; at low water the rocks are visible between the rollers, and there are depths of 12 and 14 fathoms close around it. Hill Island bearing northward of 338° leads westward of it.

Sail Rock, $2\frac{3}{4}$ miles northeastward of West Shoal, is 8 feet high. The extreme of the shoal on which it stands is $\frac{1}{2}$ mile southward of the rock, with a rock awash near its edge, and there are depths of from 5 to 8 fathoms $\frac{1}{2}$ mile eastward and westward of Sail Rock.

False Rock, $4\frac{1}{2}$ miles north-northeast of Sail Rock, is a solitary rock 10 feet high, joined to Sail Rock by the chain of shoals and reefs already mentioned. There are depths of 8 fathoms $\frac{1}{2}$ mile eastward of it, and the extreme of the shoal on which it stands is 1 mile north-northwestward of it.

There is no safe passage between Sail and False Rocks.

Unguan or Tree Island, 11 miles southeastward of Hill Island, is $\frac{3}{4}$ mile long in a north and south direction, 130 feet high, and has a dense clump of trees on its summit. A reef of rocks extends 1 mile southeastward of its south point, the whole of the eastern side is foul to a distance of nearly a mile, and foul ground $\frac{3}{4}$ mile northeastward of its north point; a patch with a depth of 4 fathoms over it is reported 1,400 yards northwestward of that end of the island.

Shoals.—Three patches lie on a southwest line from the north point of Unguan Island, the outer, about 3 miles distant, having a depth of 7 fathoms over it; a $6\frac{1}{2}$ -fathom rocky patch is situated $4\frac{1}{2}$ miles south-southwestward of the island.

Cutters Patch, a small shoal on which the least depth is $2\frac{1}{2}$ fathoms, over rocky bottom, lies about 2 miles north-northwestward from Unguan Island.

East Reef, $4\frac{1}{2}$ miles north-northeastward of Unguan Island, is nearly 1 mile long in a north and south direction and $\frac{1}{2}$ mile wide; it dries at half tide and has $5\frac{1}{2}$ to 7 fathoms round it, except northeastward, where shoaler water extends $\frac{3}{4}$ mile.

Childers Channel, between West Shoal and the shoal on which are Sail and False Rocks on the west and Cutters Patch and East Reef on the east, is nearly 4 miles in width, with depths of 9 to 15 fathoms; when West Shoal is breaking this channel is a good one.

Directions.—To proceed through Childers Channel, West Shoal should be rounded at the distance of 1 mile and a 49° course steered, which will lead 2 miles northwestward of East Reef.

Nerbudda Shoal, 6 miles in length in a northeast and southwest direction, within the 10-fathom contour lines, is a bank with a general depth of 6 to 10 fathoms, but there are several shoal heads upon it.

Near the northwestern edge and 4 miles southeastward of the south point of Unguan Island is a shoal with a depth of $1\frac{1}{2}$ fathoms over it, and $1\frac{1}{2}$ miles southward of this for about that distance across the center of the shoal are several patches, the shoalest having 3 fathoms water over it.

At the southwest end of the shoal and about $5\frac{1}{2}$ miles south-southeast of Unguan Island is a mud volcano which was in a violent state of eruption in April, 1908, when it was seen from the shore, a distance of 25 miles; it is now about 600 yards in extent, 1 foot above water, and the sea breaks over it. It is not considered probable that

this formation will remain visible at high water for any length of time.

A patch, with a least depth of 8 fathoms over a coral bottom, is situated $2\frac{1}{4}$ miles southwestward of the mud volcano.

The channel between Unguan Island and Nerbudda Shoal is 3 miles wide, has general depths of 11 to 14 fathoms, and is much used owing to its being well marked by Unguan Island.

Unguan Island bearing northward of 350° leads westward of the mud volcano on Nerbudda Shoal, and from a position 3 miles southward of Unguan Island a 46° course leads through in mid-channel.

Tidal streams.—The tidal streams on the Arakan coast set northward during the flood, southward during the ebb, and are much influenced by the immense tidal tracts of backwater. Local indrafts are strong during the north-going stream, but the outset is small with the south-going stream. There are no rapid tidal streams between Kyaukpyu and Sandoway, except at Ramree Harbor Entrance.

Coast.—Sandoway, also known as Thandwe (Iron Bound), is a mountainous district, the Arakan Yoma Range sending spurs which reach to the coast, these again throwing out a number of side spurs parallel to the main range. Southward of Sandoway River the coast is rugged with few places of shelter. The rivers draining the country are but mountain torrents to within a few miles of the sea.

Sandoway River flows into the sea southward of Singaung Island, from the south end of which a dry sand spit and shoal water extends to Drunken Sailor Rock; a rest house stands on the southern end of Singaung Island. Sandoway Town is about 15 miles up the river, which rises in the hills to the southeastward.

The river is navigable by large boats; and by small steamers at ordinary high water to the town, above which for a short distance the river is tidal; steamers of from 6 to 8 feet draft can ascend to about 4 miles below the town.

- **Landing.**—When the wind is westward of north a heavy surf breaks along the coast making landing in boats hazardous.

Drunken Sailor Rock, 2 miles westward of the southwest point of Singaung Island, is a patch, 1,200 yards in length, in a northwest and southeast direction, its shoalest portion nearly drying at low water, when there is generally a break on it.

Buoy.—A red conical buoy is established southward of this rock, about $\frac{1}{4}$ mile westward of the west extreme of Zalattaung Island; this buoy is generally removed from May 1 to October 1 annually.

Zalattaung Island, on the southern side of Sandoway River entrance, is 180 feet high, and about $\frac{1}{4}$ mile in length, in a northwest and southeast direction. Rocks and foul ground extend about $\frac{1}{4}$ mile south-southwestward of its western end, and from the extreme of

this foul ground there are soundings of 4 and 5 fathoms for 1,200 yards southwestward.

Light.—From a steel trestle, 16 feet in height, erected on the west extreme of this island, is exhibited from the beginning of October to the end of May, a fixed red light elevated 40 feet, and visible 6 miles. (For sector see Light List.)

Singyat Island, the seacoast of which is a mile in length, lies southeastward of Zalattaung Island, separated from it by a narrow channel filled with rocks.

Gwataung, 610 feet high, southeastward of Singyat, is a good landmark, and is the only hill of any considerable elevation on this coast.

Zalattaung, Singyat, and Gwataung appear like three islands from the southward and westward, but from the northwestward the three seem one island.

Anchorage.—There is anchorage in a depth of about 6 fathoms, over mud, northward of Drunken Sailor Rock, with the rest house bearing 120°, and a remarkable tufted clump of trees, 145 feet high, on Singaung Island, 2 miles farther north 71°.

Steamers of the British India Co. find good anchorage southward of Drunken Sailor Rock, in the northeast monsoon, but in the southwest monsoon it is exposed and dangerous. In the southwest monsoon the port is considered closed.

Directions.—Steer about 81° for the rest house, which should lead southward of Drunken Sailor Rock, marked by a red buoy, and when Zalattaung bears 180° haul to the southward to round the sand spit off Singaung.

A steam launch drawing 3 feet can ascend the river to Sandoway with the flood; reaching Kinmaw, a large village, at nearly low water, whence a road leads to the town, a distance of 5 miles.

Tides.—It is high water, full and change, at Singaung Island at the mouth of Sandoway River at 9h. 14m.; springs rise 9 feet and neaps 6½ feet; neaps range 3½ feet.

Sandoway Town, the headquarters of the district, is situated on the left bank of the river, 15 miles from its mouth and from 4 to 5 miles from the coast; it lies in a hollow surrounded by hills, the native town being backed by one on which stands the civil station occupied by the European officials. In 1901 the population was 2,845.

Communication.—Steamers of the British India Steam Navigation Co. from Calcutta and Rangoon call weekly off Sandoway River Entrance, except during the Southwest Monsoon, when the mails are brought from Kyaukpyu via Taungup by backwater. A steam launch maintains communication between the roadstead and the town.

Trade consists chiefly in the export to Akyab and Kyaukpyu of rice, tobacco, sessamum, plantains, betel leaf, salt (made by boiling and partly by solar evaporation), salt fish, fish paste, dhani leaves for thatching, and boat building.

The import trade consists of a piece of goods, twist, betel nut, crockery, hardware, and various articles for domestic use.

Climate.—Three seasons follow each other with regularity, but with occasional variation in duration and time of commencement.

The cold season from November to February, when the dew is exceedingly heavy and the nights are chilly, the winds light, usually at first from northwest and northeast, gradually veering to west and east. From February to May there are dense fogs during the evenings and mornings, and the wind is westerly.

Toward the middle of May thunderstorms, with lightning, squally weather, and southeast and southwest winds usher in the rainy or warm season, which ends about October, with still more violent atmospheric disturbances and strong winds from south and southwest, gradually becoming variable, till, toward the end of October, they settle and the cold weather begins.

Coast.—From Gwataung the coast is low and sandy and trends about 9 miles in a south-southeast direction to Apau-ye Islet, 295 feet high, with a bay to the northward of it, which is foul; about 2 miles southeastward of Apau-ye Islet is the northern entrance point to Andrew Bay.

Andrew Bay is about 3 miles in extent, its central part, about half that area, being clear of dangers, with good holding ground. Money Point, on the southern side of the entrance, is a small peninsula, the summit of which, 395 feet high, with detached trees on it, forms a conspicuous mark easily recognized from seaward.

Sandoway Bay, immediately eastward of the northern entrance point, is small, and has a small stone landing jetty, from which a road leads to Sandoway, a distance of 10 miles, passing through Lintha and Ngapali, two coast villages. Mayo Bay, in the southeast corner of Andrew Bay, affords shelter during the southwest monsoon, but a shoal with a depth of $2\frac{1}{2}$ fathoms over it, situated in the center, contracts the anchoring space.

Mills Patch.—A shoal with a depth of $3\frac{1}{2}$ fathoms over it, thrown up by a small mud volcano in 1908, lies $4\frac{1}{2}$ miles westward of Money Point, and is a danger to vessels making Andrew Bay.

Anchorage.—Andrew Bay affords good anchorage in fine weather, but it is exposed to the full force of the southwest monsoon.

Water.—A well of good water is situated on the shore of Sandoway Bay, in the northern part of Andrew Bay, and here native boats obtain water.

Tides.—It is high water, full and change, in Andrew Bay at 9h. 20m.; springs rise 8 feet, neaps rise 5 feet; neaps range 3 feet. (December to April.)

From Money Point the coast trends in a southerly direction for a distance of 4 miles, thence eastward about $5\frac{1}{2}$ miles, forming a promontory which extends nearly 5 miles from the general direction of the coast; at Hmau-gon, about $\frac{3}{4}$ mile eastward of the southwest point of the promontory, is a white pagoda, which is a conspicuous object from seaward when the sun is shining.

A large area of foul ground extends more than 3 miles westward of the promontory, and should be carefully avoided; the outer patch, which dries 3 feet, being 4 miles west-southwestward of Money Point.

From the pagoda, which has a remarkable rock eastward of it, the coast turns to the eastward for about 5 miles and then to the southward for $15\frac{1}{2}$ miles to Bluff Cape, a conspicuous point. Padaung Islet is situated in the bight at the turn of the direction of the coast, and beyond $3\frac{1}{4}$ and $4\frac{1}{2}$ miles, respectively, are the entrances to Kamyit and Salu, two small rivers; Kyeintali River, entering the sea about 2 miles eastward of Bluff Cape, is navigable for boats.

Dangers.—Numerous shoals and banks, generally of coral formation, exist to the westward of this coast, and this locality requires exceedingly careful navigation, especially during the southwest monsoon.

Carpenter Shoals consist of two separate shoal areas, each about $1\frac{1}{2}$ miles square, the western of these, situated $12\frac{1}{4}$ miles south-south-eastward of Unguan Island, has a least depth of $3\frac{3}{4}$ fathoms, over its center, with a bottom of coral rock.

The eastern shoal, on which there is a least depth of $2\frac{1}{4}$ fathoms, over a similar bottom, is about 3 miles east-southeast of the western, and several banks, with depths under 10 fathoms, exist in this locality, but none constitute dangers.

Foul Island (Nanthakyun), latitude $18^{\circ} 03' 51''$ north, longitude $94^{\circ} 05' 39''$ east, an active mud volcano, 551 feet high, nearly square, and about 1 mile in extent, is thickly wooded, except for a strip on its western side, where the volcano, when in activity, has cleared away the trees and formed a bare lane, or course, extending down to the water; the crater, situated to the westward of, and just below, the summit, was in violent eruption in February, 1908, with flames reported to reach a height of 500 feet above the summit.

The position given is that of the summit ascertained by the survey in 1908.

Shoal water extends nearly $\frac{3}{4}$ mile off the northeast point of Foul Island.

Anchorage.—Good anchorage may be obtained in depths of from 8 to 10 fathoms, over a bottom of sand and mud, at a distance of 1 mile from the north end of the island.

Supplies.—Fish are very numerous over the coral shoals in the vicinity of Foul Island, especially rock cod and red mullet, and are easily caught.

Brougham Shoal, with less than 1 fathom water over a rocky bottom, and nearly always breaking, is about $\frac{1}{2}$ mile in extent, and dangerous; it lies $4\frac{1}{4}$ miles north-northeastward of the summit of Foul Island.

New Shoal, with a depth of 3 fathoms over rocky bottom, is situated 9.1 miles 80° from Foul Island Summit.

Satellite Ledge, with 14 fathoms water over it, lies 4 miles eastward of New Shoal.

Vestal Shoal, with a least depth of 5 feet over it, lies 6.6 miles 102° from Foul Island Summit; it generally breaks, but, having an area of nearly 1 mile, it is dangerous.

Robinson Shoal, of small area and composed of coral, with a least depth of 4 feet over it, and generally breaking, is situated $1\frac{1}{4}$ miles eastward of Vestal Shoal, with a channel in which the depth is 25 fathoms between.

William Shoal consists of two rocky heads nearly 1 mile apart, with deep water between; the western has a depth of $5\frac{1}{2}$ fathoms over it, and the eastern, with $2\frac{1}{2}$ fathoms water, is situated $13\frac{1}{4}$ miles 105° from Foul Island Summit.

Investigator Ledge, small and of coral, with a least depth of 12 fathoms, is $4\frac{1}{4}$ miles southeastward of Foul Island Summit.

Currents.—The currents in the vicinity of these shoals are influenced by the monsoon, but it has been observed that they are also affected by the tides, both in strength and direction; they set strongly across the shoals.

Caution.—If proceeding eastward of Foul Island, pass within 3 miles of it, to insure clearing the above shoals.

Coast.—Bluff Cape, rising steeply from the sea to a height of 450 feet, is a moderately conspicuous landmark, and from it the coast trends somewhat eastward of south for a distance of 25 miles to Gwa Bay, with between some summits on the coast, which are easily recognized from seaward; of these may be mentioned Bowendoung, 1,785 feet; High Peak, 1,920 feet; Quoin Hill, 830 feet; and Brown Cape, or Button Hill, 409 feet, near the coast, and North Sharp Peak, 3,760 feet, and South Sharp Peak, 2,320 feet high, on the back range of hills.

The only village of any importance on this stretch of coast is at Hswathwa River, which, like Kyeintali River, has a narrow entrance

and a shallow bar, but Hswathwa River, being almost closed by reefs, can only be approached by a passage from the southward, near the shore. Hswathwa Village exports a certain amount of rice and salt fish to Akyab during the fine season.

Foul rocky ground extends off Hswathwa River mouth for a distance of $2\frac{1}{2}$ miles.

Thyne Bank and White Bank, of coral, have 15 and 12 fathoms water over them, and lie, respectively, 13 miles west-southwest and $10\frac{1}{2}$ miles southwestward of High Peak.

Gwa is a small town at the narrow entrance to the river of the same name, which is fronted by a bar of sand, just outside the narrows, on which the greatest depth at low water is 7 feet. A reef of rocks extends about $\frac{3}{4}$ mile southwestward of Rocky Point, the northern point of Gwa Bay.

Anchorage.—The anchorage in Gwa Bay, outside the river mouth, in depths of from 4 to 6 fathoms, is open to westerly winds.

Tides.—It is high water, full and change, at 9h. 30m. in Gwa Bay; springs rise 8 feet, neaps rise 5 feet; neaps range 2 feet.

Town.—Gwa is surrounded by a grove of fruit trees, the houses are generally good, and the roads broad and cross at right angles; in 1901 the population was 1,436. During the northeast monsoon a little trade is carried on by sea with Bassein District to the south, and Chinese junks occasionally anchor off the village.

Communication.—A small steamer from Sandoway, stopping at Kyeintali and Hswathwa en route, calls once every week during the fine weather season, and a road connects Gwa and Sandoway, by which mails are sent weekly; there is a post and a telegraph office.

Hospital.—A hospital was in course of construction in 1908.

Trade.—A little trade in grain and salt fish is carried on during the fine weather, these being principally exported to Akyab.

Gwa Island, $2\frac{1}{2}$ miles southwestward of the entrance to Gwa Bay, is $\frac{1}{2}$ mile in length in a north and south direction, 144 feet high, and forms an excellent mark.

A rock, which dries 5 feet, is situated $1\frac{1}{2}$ miles 24° from Gwa Island, and foul ground extends around the island and between it and the mainland; the channel to the eastward of the island is only navigable for boats and for those who have local knowledge respecting the rocks in it.

Bassein District.—From Gwa the Bassein District has a coast line of nearly 100 miles to the entrance to Bassein River, with no ports of any importance.

St. Johns or Church Rocks, 13 miles 238° from Gwa Island, are four in number, and extend for a distance of about $\frac{1}{4}$ mile in a northwest and opposite direction; the largest rock, 40 feet high, on a southwesterly bearing, resembles a church.

The rocks are steep-to at the northern end, but shoal water extends for a distance of 1,200 yards to the southward of them.

Coast.—From Gwa Bay the coast trends in a general south-south-westerly direction for nearly 40 miles, and then southward to Cape Negrais; off it the depths are very irregular, with numerous off-lying rocks and dangers, so that it is not advisable to navigate inside depths of from 20 to 25 fathoms.

The coast is rocky and broken up into several small bays, which, although affording anchorage in fine weather, gives but little shelter in the southwest monsoon. Danson Bay, about 24 miles southward of Gwa Bay, is the best of these, being well sheltered from the south and southwest.

Bomie Bay, about 15 miles southward of Gwa Bay, has also a river, navigable for boats, and those which carry on a certain amount of trade in the fine season are cutter shaped and junk rigged.

There are also rivers, navigable for boats, at Kyaung-Tha, Hsengma or Round Island, and Nga-yot-chaung, all having a certain amount of export trade in rice, and dried fish, in fine weather; Hsengma has a timber industry and a sawmill.

Danson Bay, about 8 miles southward of Bomie Bay, and the most protected anchorage from the south and southwest, between Cheduba Strait and Cape Negrais, extends about 3 miles in a southeast direction, and is about 2 miles in width at its entrance. Round Hill, 637 feet, and Thumb Hill, 780 feet high, situated about 2 miles inland from the eastern coast of the bay, are very conspicuous from seaward.

Anchorage for large vessels may be obtained in depths of from 5 to 6 fathoms, but when entering West Sandy Islet should be given a good berth, to avoid the reef and rocks which extend about a mile westward of it.

Supplies of fresh provisions are almost impossible to be obtained, but water may be procured from two streams situated just to the northward of the entrance.

Kyaung-Tha River.—High Island, 14 miles southward of West Sandy Islet, is small, 130 feet high, and lies about a mile westward of the entrance to Kyaung-Tha River, which is navigable for boats, and the nearest point on this coast to the town of Bassein.

Several reefs are situated off the entrance to the river, and a heavy swell breaks on the bar, except in fine weather; boats intending to enter the river should pass to the northward of High Island, and exercise care when landing, on account of the reef off the river entrance.

Communication.—There is a large village at Kyaung-Tha, and the road over the hills having been recently (1909) improved, it is expected that a postal service will be established.

Calventuras (Hgnettaung) consist of two groups of rocky islets, the northwest group being 10 miles westward of Broken Point, which point is about 3 miles southwest of High Island; the highest rock of the northwest group is 125 feet high, and North Island, of southeast group, is about 4 miles east-southeast of it, with a channel between in which there is a depth of 24 fathoms.

North and South Island, of southeast group, are 130 and 80 feet high, respectively, and the summits of all the islets are wooded, forming good marks. There is a navigable channel between southeast group and the mainland, but the channel between North and South Islands should not be attempted, as a rock which dries 7 feet lies midway between them, and there are two large rocks to the northward of South Island.

Coast.—Between Broken Point and Koronge Island, a distance of $23\frac{1}{2}$ miles, the coast is broken and has several islets and off-lying reefs, the principal being Chaung-gyi Island, 110 feet high, Round or Hsengma Island, 130 feet, Mile Stone Rock, 40 feet, Little Quoin Island (Thit-yaung), 130 feet high, High Island, North, West, and South Reefs, and Saba Island and Rocks.

Alligator's Head, a large rocky promontory situated nearly 20 miles south-southwest of Broken Point, when seen from seaward has the appearance of an alligator's head, facing to the southward; it is the northern point of Nga-Yot Bay.

Sinma or Hsengma, a large village situated about $10\frac{1}{2}$ miles southward of Broken Point, on the northern side of the entrance to the Thit-po River, has a steam sawmill where timber is prepared for export, and extensive repairs are carried out to local trading boats.

The Thit-po River is navigable for boats, and those intending to enter should pass to the northward of Round Island, which lies westward of the entrance, to avoid St. Mary's and other rocks; the river bar should only be attempted at high water.

Supplies.—A few fowls and some fruit and vegetables may be obtained.

Vibart Shoal, $1\frac{1}{2}$ miles in length in a north and south direction and $\frac{1}{2}$ mile in breadth, has a least depth of $2\frac{1}{2}$ fathoms, over sandy and rocky bottom; it lies $2\frac{1}{2}$ miles southwestward of Round Island.

Mile Stone Rock, about $6\frac{1}{2}$ miles southwestward of Round Island and $4\frac{1}{2}$ miles from the coast, is a large solitary rock, 40 feet high, with deep water all round it and no outlying dangers.

Nga-yot Bay, northeastward of Koronge Island, is about $3\frac{1}{2}$ miles in width, open, and affording little protection, except from the southward; as there are several dangers in the bay it should not be used by large vessels. Nga-yot-chaung, a river navigable for boats, enters the bay at its southern end, and Nga-yot-Taung, 1,317 feet high, and

one of the most conspicuous mountains on this coast, is about 4 miles inland from the eastern shore of the bay.

North, West, and South Reefs, with High Island, lie off the coast to the northward; a patch with a depth of 3 fathoms over it lies in the center of the bay, and in its southern part are Saba Rocks, with a $4\frac{1}{2}$ -fathom patch between.

A rock, 4 feet high, is situated $\frac{3}{4}$ mile northwestward of North Rock of Koronge Island, and several reefs and outlying rocks are off the coast.

Koronge Island, $1\frac{1}{2}$ miles in length in a north and south direction, about 800 yards in breadth at its southern, and tapering to a point at its northern, end, is rocky, wedge shaped, 265 feet high, and presents a very rugged appearance. It is quite precipitous on its inshore side, and North Rock, large and detached, is situated off its northern end.

The channel between the island and the mainland is about 1,200 yards in width, but, being obstructed with reefs and foul ground, it is not navigable for anything larger than boats, and they should keep close to the island side when passing through.

Anchorage.—Good anchorage may be obtained in a depth of 6 fathoms, over sand, between the south end of Koronge Island and the mainland, protected from the north and northwest, but care is necessary to avoid Crawford Shoal and a rock which dries, situated 1 mile southeastward of the southeast point of Koronge Island.

Crawford Shoal, lying $2\frac{1}{2}$ miles southwestward of the southwest point of Koronge Island, consists of a group of rocks which dry 4 feet, with deep water close to the northern side, but shoal water extending for a distance of $\frac{1}{2}$ mile to the southward.

May-gaumgaun, Ung-chume, and Lichune Islands, 65, 175, and 120 feet high, respectively, form a group situated from 6 to 9 miles southward of Koronge Island, and about 1 mile from the coast; rocks and foul ground extend for some distance round all these islands, and a patch on which the depth is $2\frac{1}{2}$ fathoms lies about $\frac{1}{2}$ mile southwestward of May-gaumgaun.

Saingbain Kieu, or the Buffaloes, a group of large detached rocks, extending for 3 miles in a direction parallel to the coast, from which they are distant about 2 miles, are very conspicuous, several of them showing white; North Twin and South Rock are the northernmost and southernmost, respectively, and Pillar Rock, 43 feet above high water, is the highest.

Round Cape, 16 miles southward of Koronge Island, is a conspicuous, thickly wooded point, 340 feet high, off which shoal patches with a least depth of $4\frac{1}{2}$ fathoms lie at a distance of $1\frac{1}{2}$ miles in northwest and west directions.

Conical Mountain (Yot-pa), 736 feet high and situated 4 miles southeastward of Round Cape, is conical shaped and conspicuous, showing distinctly from seaward in all directions. This mountain, with Spike Hill, 850 feet, and Fat Hill, 650 feet, are the most easily distinguished summits between Koronge Island and Cape Negrais.

Black Rock, about 5 miles south-southwest of Round Cape and 2 miles from the coast, is a solitary, dark-colored rock, 4 feet above high water.

Cape Negrais, 14 miles southward of Round Cape, is prominent, with cliffs steep to the water's edge; the summit of the cape, about $\frac{1}{2}$ mile inland, is 410 feet high and forms the extremity of a spur of the Arakan Yoma, which range stretches to the north-northeastward nearly parallel to the coast of Burma.

Pagoda Point (Mawdeng), the southwest extreme of Burma, lies 6 miles south-southeastward of Cape Negrais, and between is a succession of low hills most of them densely wooded; toward Pagoda Point some remarkable bare, reddish slopes of blown sand show a well-defined edge of dark foliage near their summits.

The land in this vicinity should not be approached to a nearer distance than 3 miles, and even then with caution, as, in addition to a reef which skirts this coast, there are many outlying rocks.

Currents.—Between Gwa and Cape Negrais the currents running with the monsoon take the direction of the coast, and rarely exceed a rate of 1 knot an hour.

Juanita Shoal, a coral bank about 10 miles in length, within the 100-fathom contour line, in a north and south direction, and 3 miles in width, with a least depth of 16 fathoms, is situated 30 miles westward of Cape Negrais.

Directions.—A sailing vessel beating round Cape Negrais should shoal the water, standing inshore, to about 10 fathoms, and stand off to depths of 18 or 20 fathoms. In proceeding northward a good offing should be kept, passing westward of all rocks and shoals and using the lead frequently.

From the proximity of the mountains, the winds are baffling during the northeast monsoon, and in the southwest monsoon the weather is bad, so that it is generally inadvisable to work up inshore; but if such a course should be determined on, keep in the anchorage depths, and take advantage of the land and sea breezes, and the uncertain currents.

CHAPTER VI.

THE NICOBAR, ANDAMAN, AND COCO ISLANDS.

Nicobar Islands.—The Nicobar Group extends for a distance of 163 miles in a north-northwest and south-southeast direction, with an extreme width of 36 miles, and consists of 12 inhabited and 7 uninhabited islands. The group is fully described in Chapter I.

Great Nicobar (native name Loong), the southern and largest of the islands of the Nicobar Group, extends for about 29 miles, in a north and south direction, with breadths of from 7 to 14 miles; its northern part is the highest, where it attains, in Mount Thuillier, an altitude of 2,105 feet; the southern part, although lower, is still high.

Near the center a mountainous range, with a known height of 1,333 feet, extends northeastward across the island; the western side of the island, being open to the southwest monsoon, has not been examined. The whole island is thickly covered with trees, and the soil is of great fertility. In the interior the natives are of a different race to those of the coast, and do not intermix with them.

South (Galathea) Bay, at the southern end of Great Nicobar Island, is an indentation about $1\frac{1}{2}$ miles in extent, where there is fair anchorage during the northeast monsoon in 9 to 10 fathoms, but, owing to its position, the heat is excessive.

Walker Island, small and flat, lies on the western side of the bay, about 1,800 yards northward of Parsons Point, the southern point of Great Nicobar.

Galathea River (Dak Kea), small and navigable for a considerable distance by boats, flows into the head of the bay, but a sand bar closes its mouth at low water.

Landing can be effected by canoes at a gap in the reef about $1\frac{1}{4}$ miles northward of Walker Island, and at a similar gap on the eastern side of the bay $\frac{1}{2}$ mile northward of Hayward or Kwangtung Point, the eastern entrance point of the bay.

East coast.—The east coast of Great Nicobar Island is imperfectly known; it is hilly, wooded down to the sea, and indented; probably there are places where anchorage may be obtained during the southwest monsoon, when the water on this side of the island is smooth.

From Hayward Point the coast trends in a north-northeast direction of $3\frac{1}{2}$ miles, and then turns to the westward, forming the southern

side of a bight $6\frac{1}{2}$ miles in length, with several indentations in it, the southern being named *Mataita-anla*.

Boat Rock, about a mile southeastward of the northern point of this bight, has three smaller rocks southwestward of it. Campbell Bay is situated northward of the bight, and southward of its north entrance point is Cerberus Rock.

From Koal-ta-pain, the point immediately northward of Campbell Bay, the coast trends in a north-northwest direction for 11 miles to Laful Anchorage.

Laful Anchorage is an open bight, about $\frac{3}{4}$ mile in length in a north and south direction, with a ledge of shoal water nearly 400 yards in width extending off it which affords anchorage; this ledge is apparently steep-to.

Directions.—Steer 270° for the middle of the southern half of the sandy beach, which is conspicuous from seaward, and anchor just before the southern part of the coast is shut in by South Point; caution is necessary, as the water shoals suddenly.

Trinkat Champlong Bay, situated 3 miles north-northwestward of Laful Anchorage, affords safe anchorage in the southwest monsoon in depths of from 7 to 10 fathoms, $\frac{1}{2}$ mile offshore. At the entrance of the bay the water shoals suddenly from 22 to 10 fathoms; thence to the shore the soundings decrease regularly, but a vessel should not approach the shore to a less depth than 6 fathoms.

A shoal, with a depth of $2\frac{1}{2}$ fathoms over it, was reported, in 1887, about $1\frac{1}{2}$ miles northeastward of Murray Point, the north entrance point to Trinkat Champlong Bay, but its position is doubtful.

Kabra (native name Konwana), a small island 309 feet high, is nearly 3 miles northward of Murray Point.

Ganges Harbor, on the western side of a point which lies about $2\frac{1}{2}$ miles westward of Murray Point, is a bight about $2\frac{1}{2}$ miles in width in an east-northeast and opposite direction, and nearly midway between its entrance points is a middle ground, upon which there are depths of from $4\frac{1}{2}$ to 8 fathoms, and two rocks with about $\frac{1}{2}$ fathom water over them; on each side of the middle ground is a channel with depths of from 17 to 27 fathoms.

Shoal water, on which there is a patch of $3\frac{1}{2}$ fathoms, extends nearly 1 mile westward of the eastern entrance point of the harbor.

Anchorage may be obtained in from 9 to 16 fathoms water over a bottom of coarse sand and clay.

Kondul Island (native name Lamongshe), 3 miles westward of the west point of Ganges Harbor, is rocky, 2 miles in length in a north-northwest and south-southeast direction, with a hill, 400 feet high, near its center. The northern side of this island is lofty and rocky, but safe landing may be obtained on its eastern side.

Anchorage may be obtained on the eastern side of the island in a depth of 7 fathoms about $\frac{1}{2}$ mile from the shore.

Kondul Harbor, between the northwest side of Great Nicobar Island and Kondul Island, from which it receives protection from the northward, is an airy anchorage, distantly situated from mangrove swamps.

Shoal.—A shoal with a depth of $2\frac{1}{2}$ fathoms over it, but which has not been examined, lies about 1,600 yards south-southeastward of the southeastern point of Kondul Island.

Anchorage.—There is anchorage in depths of from 12 to 17 fathoms, over sand and coral, between Kondul Island and the shore, and eastward or northeastward of the shoal; or off the western side of the island in 10 to 12 fathoms water, according to the direction of the prevailing wind.

West coast.—The west coast of Great Nicobar Island, which, as already stated, has not been examined, trends to the southward for a distance of about 11 miles from the northwest extreme of the island to a point on the western side of Casuarina Bay, from which it trends to the south-southeastward for 19 miles to Parsons Point, the south extreme of the island.

Dangers.—A bank, with depths of 7 to 8 fathoms, on which there may possibly be less water, extends 3 miles offshore, about 7 miles southwestward of Kondul Island, and there are irregular soundings some distance northward and westward of the bank.

A patch of small extent on which a depth of $4\frac{1}{2}$ fathoms was obtained, but probably having less water, is situated on the western side of Great Nicobar, $2\frac{3}{4}$ miles south-southeastward of the southwestern point of the headland on the northwestern side of Casuarina Bay. For a distance of 5 miles to the southward of this patch numerous shoals have been reported.

The edge of the plateau on which Great Nicobar Island stands, and which apparently extends a considerable distance from its coast, has not been determined.

Anchorage.—Casuarina Bay affords good anchorage during the northeast monsoon, in a depth of 11 fathoms, about 1 mile to the southward of the northwest point of the bay.

At the entrance to a bight between the villages of Kopen-heat and Tae-angha, $5\frac{1}{2}$ miles south-southeast of Casuarina Bay, there is anchorage in a depth of 15 fathoms, about 1 mile from the shore, but great care is necessary in approaching either of the above anchorages, as numerous shoals are reported to exist from 3 to 5 miles offshore.

Caution.—Great Nicobar and Kondul Islands should not be approached closely, as unknown rocks may exist.

St. Georges Channel separates Great and Little Nicobar Islands. The water in it is deep with an uneven bottom. The tidal streams set fairly but strongly through the channel, the flood to the northeastward, the ebb to the southwestward.

Little Nicobar Island (native name Ong), $12\frac{1}{4}$ miles in length in a north-northeast and opposite direction, by about 6 miles in breadth, narrows considerably toward its northern part; it is mountainous, the highest summits being Mount Deoban, 1,428 feet high, near the center of the island, and Empress Peak, 1,420 feet high, northeastward of it. The island is thickly covered with swamp and forest.

East coast.—From Cape Edinburgh, the south extreme of the island, the east coast trends in a northeast direction for about 11 miles, and then turns abruptly to the northwest for $5\frac{1}{2}$ miles to Sombrero Point, the north extreme of the island.

Menchal Island, nearly 1 mile in extent, is situated about $1\frac{1}{4}$ miles to the northward of the point where the coast changes its direction, the channel between having depths of from 21 to 30 fathoms.

Anchorage may be obtained during fine weather in from 6 to 7 fathoms water $\frac{1}{2}$ mile southwestward of Menchal Island, but the tidal streams are reported to be very strong, especially at springs.

West coast.—From Cape Edinburgh the west coast has a northerly direction for 8 miles to Pahu, and between it and Sombrero Point, a distance of $5\frac{1}{2}$ miles in a northeast direction, a bight, receding about 2 miles, is formed in which is Milo Island (native name Miloh), about 1,400 yards in length and 800 to 1,000 yards in breadth.

Dangers.—Coral reefs extend off the coast of Little Nicobar, eastward of Pulo Milo, and a 3-fathom patch lies about $\frac{1}{2}$ mile eastward of the northeastern point of the latter island.

Anchorage may be obtained in the channel between Milo Island and Little Nicobar, which is about 800 yards wide, with depths of 9 to 13 fathoms, over sand and coral; it is accessible in all winds and is well sheltered.

Landing can be effected on Little Nicobar and on the eastern side of Milo Island; it is believed that no fresh water for drinking can be procured.

The natives are reported to be inoffensive and willing to trade, but are very poor.

Sombrero Channel, separating Little Nicobar Island from Katchall and Nankowry Islands, is 30 miles in width between Sombrero Point and Cape Albany, the south point of Katchall; the depths are somewhat irregular, there being 51 and 305 fathoms nearly in mid-channel.

Treis (native name Taan) and **Trak** (native name Fuya) **Islets** lie about $3\frac{1}{2}$ and $4\frac{1}{2}$ miles, respectively, west-northwestward of Sombrero Point, the northern point of Little Nicobar Island; there

are sunken rocks in their vicinity, and midway between Treis, from which a reef extends $\frac{1}{4}$ mile, and Sombrero Point is a rock with less than 6 feet of water over it.

Anchorage.—There is anchorage $\frac{3}{4}$ mile northeastward of Trak in a depth of 6 fathoms, but the bottom is uneven and the tidal streams are very strong.

Meroc Islet (native name Miroe), low and about 1 mile in length, is situated $10\frac{1}{2}$ miles west-northwest of Sombrero Point; landing is only practicable on it in the finest weather.

Banks.—A detached coral bank about 7 miles long in a north-northeast and south-southwest direction and 4 miles in greatest width, with 9 to 17 fathoms on it, is situated in the northern part of Sombrero Channel, its northern edge being about 3 miles south-southeast of Cape Albany.

A patch with a depth of 12 fathoms, over yellow clay, lies $12\frac{1}{2}$ miles westward of Cape Albany, Katchall Island, and other shoal ground may exist in the vicinity.

Tidal streams.—In Sombrero Channel the flood stream sets northwestward and the ebb stream southeastward; the streams are said to attain in places a rate of 5 knots at springs.

Katchall Island (native name Tehnyu) is irregular in shape, about 11 miles in length in a northwest and southeast direction, and about 6 miles in width, except at its southern part, where it is about 2 miles; there are some bays around its coast. The island, which is covered with forest, reaches a height of 835 feet; it furnishes coconuts, ambergris, tortoise shell, and edible birds' nests.

South Bay, about 3 miles in width, has rocks and foul ground in it and should not be entered.

Hoinipoh Bay, situated about midway on the east side of the island, affords good anchorage in a depth of 8 fathoms, with the village bearing 259° , distant 600 yards; it is much frequented by vessels trading to the island.

East Bay is reported to have very irregular depths, varying from 5 fathoms to no bottom at 20 fathoms, but anchorage may be obtained in it with the east point bearing 149° , distant 1 mile.

West Bay affords anchorage in a depth of 9 fathoms at a distance of 1 mile south-southwestward of its northwest point, but a southwest swell is reported sometimes to set in during the northeast monsoon, and the tidal streams attain a rate of 2 knots across the entrance.

Landing.—Good landing can be effected inside the northwest point of West Bay.

Revello Channel, between Katchall and Camorta and Nankowry Islands, is about $3\frac{1}{4}$ miles in width and is apparently free from dangers.

Nancowry Island, eastward of Katchall, is $6\frac{1}{2}$ miles in length in a north and south direction, and about $4\frac{1}{2}$ miles in extreme breadth; it is 534 feet high and thickly wooded. A reef of rocks, dry at low water, extends about a mile southward of Cape Connaught, its southern point.

Camorta Island (native name Nankauri), northward of Nancowry Island and separated from it by Nancowry Harbor, is 14 miles in length in a north and south direction, and generally about 4 miles in width; its average height is about 200 feet, but the summit of the southern part is 735 feet, and a hill in the middle of the island is 435 feet high. On both sides of the island there are villages and huts along the coast. Camorta is picturesque, owing to the alternations of forest and grass slopes, with the white coral beach crowned with coconut palms.

Nancowry Harbor, between Camorta and Nancowry Islands, is commodious and sheltered from all winds; it has two entrances, one on the east, and the other on the southwest, and can be entered or left without difficulty in either monsoon.

On the northern side, within the eastern entrance, is Fort or Octavia Bay, in which the depths are from 10 to 16 fathoms, and opposite it on the southern side is Spiteful Bay, with from 5 to 13 fathoms water, while between these is Cross Harbor with depths of from 12 to 27 fathoms; westward of the latter a channel about 750 yards in width communicates with Satellite Bay, on the north, and Wasp Bay on the south side, which have general depths of from 8 to 30 fathoms.

Nancowry Harbor—Outer anchorage.—Vessels can anchor about 1 mile eastward of Naval Point in a depth of 12 fathoms, sheltered anchorage and good holding ground.

Eastern entrance—Depths.—The eastern entrance, in which the depths are from 19 to 22 fathoms, is about 450 yards in width between the shoal water extending about 200 yards off Jub Point on the south, and about 400 yards off Naval Point on the north side, the latter, marked by a white beacon, which must be left to the northward when entering.

Eastern Shoal.—This small shoal of $4\frac{1}{4}$ fathoms is situated in mid-channel at the eastern entrance, at $1\frac{1}{2}$ miles eastward of Reid Point.

A promontory about 1 mile wide, of which Reid Point is the northeast, and Mayo Point the northwest extreme, forms the southern side of the eastern entrance, and Naval Point the southeast extreme, of Camorta, is the north entrance point.

Beacons.—The extremity of the reef, extending 400 yards southward of Naval Point, is marked by a beacon, consisting of an iron post, surmounted by a drum painted white, the whole 5 feet above high water.

The shoal extending about 300 yards northwestward of Leda Point is similarly marked.

Western entrance—Depths.—Indian Point is on the southern side of the western entrance, its northern side being formed by the south extreme of a peninsula at the south end of Camorta, of which Man Point is the southeast extreme. The western entrance, between Indian and Man Points and leading into Wasp Bay, is rather more than 200 yards in width, and has depths of from 27 to 30 fathoms.

Burleigh Rock, 24 feet high, with a wooded summit, is connected with the point 400 yards south of Indian Point by a reef.

Shoal water extends 150 yards northwestward from Burleigh Rock.

Satellite Bay, the entrance to which is situated between Easter Point and Alfred Point, has a general depth of from 9 to 13 fathoms. Sailing vessels, when entering, should guard against sudden changes of wind.

Northbrook Patch.—This small shoal, with a depth of $2\frac{1}{2}$ fathoms, is situated in the west entrance $\frac{1}{4}$ mile southward of Reef Point, the south extreme of Camorta Island.

The depths between Northbrook Patch and Reef Point are irregular.

A conspicuous casuarina clump near Battery Point open eastward of Man Point leads southward of Northbrook Patch.

Satellite Patch, a detached patch with a depth of $2\frac{1}{2}$ fathoms, over coral, and from 4 to 5 fathoms around it, lies about 1,600 yards southwestward of Alfred Point, the northeastern point of Satellite Bay.

A narrow shoal of $3\frac{1}{2}$ fathoms, about 400 yards long in a northwest and southeast direction, is situated about 1,200 yards southwestward of Alfred Point, separated from Satellite Patch by a narrow vein of deep water.

Easter Point—Shoals.—Two shoals of $4\frac{1}{2}$ and $4\frac{1}{2}$ fathoms are situated 900 and 400 yards, respectively, east-northeastward and southeastward of this point.

Rock.—A rock which covers at high water lies 700 yards from the eastern shore of Wasp Bay, about 1 mile southward of Leda Point.

Inner anchorage.—Fort or Octavia Bay, the eastern of the northern bights, is clear of dangers, and affords excellent anchorage in a depth of about 12 fathoms, mud bottom.

It is well sheltered, but open to the sea breeze, and but little current is experienced.

Spiteful Bay, the eastern of the southern bights, is narrow, and extends southward for $1\frac{1}{2}$ miles, terminating in an extensive mud bank, dry at half ebb. It should not be entered unless the reefs in it have been previously buoyed. The most convenient anchorage is in the middle of its entrance, in a depth of about 12 fathoms, which position is open to the sea breeze.

Directions—Eastern entrance.—The coast southeastward of Reid Point should be given a berth of about 1 mile, to avoid Eastern Shoal off it, and when that point bears about 247° steer to pass nearly in mid-channel, between Jub and Naval Points, and southward of the beacon marking the shoal south of the latter point to the anchorage off the settlement. If proceeding to Satellite Bay, pass northward of the beacon marking the shoal off Leda Point.

Western entrance.—Approach from the southward to avoid the shoal water off Reef Point, which terminates in Northbrook Patch, and when the right extreme of Reef Point bears 0° , steer for it, until Burleigh Rock bears 90° , then alter course gradually for the entrance, avoiding the shoal water off Burleigh Rock, and steer in with Leda Point midway between Man and Indian Points, observing that the tidal streams run strongly between these points, and there are also eddies, so that caution is necessary. After entering the harbor it is advisable to keep over to the eastern side, steering for Itoe Village, then gradually altering course to the northward for Alfred Point. When Leda Beacon bears 90° , alter course for the flagstaff on Ray Point, passing between the shoals which extend off Leda and Alfred Points.

Tides.—It is high water, full and change, in Nancowry Harbor at 9h. 45m.; spring rise 6 feet, neaps rise 4 feet, and neaps range $1\frac{1}{2}$ feet.

Settlement.—There is no settlement northwestward of Naval Point, but a Government agent is resident, and there is a sepoy guard and a few convicts.

Water.—There is a fresh-water stream, with two wells, between Naval Point and the jetty.

Tidal streams.—The flood stream sets eastward, the ebb westward; and in the entrances the stream attains considerable strength, though weak inside the harbor.

Jetty.—A jetty extends nearly 400 feet from the shore about $\frac{1}{4}$ mile westward of Naval Point.

Supplies.—Pigs, fowls, yams, and coconuts can be procured, and a small quantity of fresh water obtained from a stream between Naval and Battery Points.

East coast.—From Naval Point the east coast of Camorta Island trends to the northward for $3\frac{1}{2}$ miles, then turns to the north-northwest for about 5 miles and north-northeastward for an almost similar distance, forming a bight which recedes about $2\frac{1}{2}$ miles. Trinkat Island is separated from this coast by Beresford Channel.

Moshoit, a village situated on the northern side of the bight above mentioned, has a reef extending off it which may be easily seen with a good light, and anchorage may be obtained about 400 yards north-

eastward of it, with the northeast extreme of Camorta bearing 14° and the northeast extreme of Trinkat 133° .

West coast.—The west coast of the island from the south extreme of the peninsula, which forms its southern part, trends in a northerly direction for $5\frac{1}{4}$ miles to Dring Harbor, with Expedition Harbor about midway. From Dring Harbor it curves around to the westward of north, and then turns northeastward to Horace Point, the north extreme of the island, the distance of each of these stretches being about 5 miles.

Expedition Harbor (Ho Ho Bay), the entrance to which is $2\frac{1}{4}$ miles northward of the southern point of Camorta, is a considerable land-locked harbor, extending $1\frac{1}{2}$ miles northeastward and then opening out to Grand Harbor, which has not been surveyed; it is separated from Nancowry Harbor by a low, narrow, irregular peninsula, but owing to the numerous mangrove swamps it is undesirable except as a temporary anchorage.

Entrance—Depths.—Satellite Point, on the southern side of the entrance, is almost free from danger, but Wasp Point, on the northern side, has a reef extending nearly 300 yards southwestward of it; the entrance between the edge of this reef and Satellite Point is about 100 yards in width, with depths of from 9 to 13 fathoms.

Anchorage.—The anchorage in a depth of 12 fathoms, over soft mud, is with Devils Point, situated $\frac{1}{2}$ mile north-northeastward of Wasp Point, bearing 344° , distant about 200 yards.

Directions.—Expedition Harbor should be approached with extreme caution, especially from the northward, as in that direction are several outlying dangers which only show at low water. Bring Edgcumbe Point on the east side of the harbor to bear 51° , and steer in with it on that bearing, passing close to Satellite Point, and when Devils Point bears 0° steer for the anchorage as convenient, but do not proceed above Devils Point, as within it the harbor has been but partially examined, and there are several shoals.

Tides.—Springs rise 8 feet.

Water.—A little fresh water may be obtained at the rivulet northward of Wasp Point, the northern entrance point, but it is said to be of doubtful quality.

Dring Harbor can only be entered by boats, but anchorage may be obtained outside in a depth of 10 fathoms, about $\frac{1}{2}$ mile westward of the entrance.

Rock.—A rock with a depth of 1 fathom over it lies about 2 miles northward of the entrance to Dring Harbor and $\frac{3}{4}$ mile offshore, and, as a depth of 14 fathoms has been found between Dring Harbor and the rocks, and breakers have been reported in this vicinity, there may be less water.

Perseus Reef apparently commences from the shore about 3 miles northward of Dring Harbor, and extends off it for a distance of $2\frac{1}{4}$ miles from a point 3 miles farther north; its northern edge then trends eastward and joins the shore reef off Koi-hoa.

Koi-hoa Village is situated $3\frac{1}{4}$ miles southwestward of Horace Point, and anchorage may be obtained in from 7 to 9 fathoms water about 1 mile offshore at the village, but no protection is afforded in the southwest monsoon by Perseus Reef.

Trinkat Island (native name Laful), on the eastern side of Camorta, is $5\frac{1}{2}$ miles in length in a north and south direction and about 1 mile in width, very low and level, with numerous coconut palms; it is nearly divided near its center by a deep bight which has a village at its head.

Beresford Channel, between Trinkat and Camorta, is about 1 mile wide, but is believed to be blocked by reefs and sand banks.

Anchorage is sometimes obtained in 8 or 9 fathoms between the north point of Trinkat and Camorta, but as there are numerous reefs in this vicinity, local knowledge is necessary to use it.

Tillanchong Island (native name Laok) is 10 miles in length in a north and south direction and less than 1 mile in width, and Cape Winifred, its southern point, is $12\frac{1}{2}$ miles north-northeastward of Horace Point, the northern point of Camorta; the island is visited occasionally by natives from Chowra and Bompoka Islands. The island is steep, with a jagged ridge, and rises at Maharani Peak, nearly in its middle, to a height of 1,058 feet.

A chain of needle-like rocks extends for a distance of nearly 3 miles southeastward of Cape Winifred, and the Isle of Man (Laouk), the highest of the chain, situated near the extremity, is 404 feet high.

Several detached rocks lie off other parts of Tillanchong Island, and Piara Rock, about 352 feet high, is situated $\frac{1}{2}$ mile northwestward of Cape Maud, its northern point.

Castle Bay, on the southeast coast of Tillanchong, is a fair anchorage in fine weather, but care is necessary to avoid a rock about $\frac{1}{4}$ mile southward of Castle Bay Point; it can be seen in a good light, and there is deep water between it and the shore.

Anchorage has been obtained on the western side of Tillanchong Island in Novara Bay.

Teressa Island (native name Taihlong), about 14 miles northwestward of Katchall, is 12 miles in length and about $2\frac{1}{2}$ miles in width, and curved in a northwest to north-northeast direction; it is sparsely populated. From a distance it appears like two islands, its central part being considerably lower than the northern or southern parts; its northern part reaches a height of 897 feet. Reefs extend from its northern, western, and southern side, but especially from the

last; it is not advisable to visit the island during the southwest monsoon.

East coast.—From the east end of the island the east coast trends in a west-northwest direction for 6 miles, and then north-northeast for about 4 miles.

Kerawa, about 4 miles from the east end, has no safe anchorage, as a depth of 27 fathoms was found at a distance of $\frac{1}{4}$ mile offshore.

Haoin or Bengala, $3\frac{1}{2}$ miles northward of Kerawa, is not a safe anchorage, although vessels sometimes anchor off it; there is good landing.

West coast.—The west coast trends in a west-northwest direction for 6 miles, and then curves gradually around to north-northeast for a distance of 9 miles.

Laksi, a village consisting of a few huts, is $3\frac{1}{2}$ miles from the east end of the island, and can be easily made out from seaward; anchorage may be obtained abreast of it about $\frac{3}{4}$ mile offshore.

Landing can often be effected through an opening in the reef at Laksi when it is unsafe at Hinam.

Hinam, a village about 4 miles northwestward of Laksi, is only visible from seaward on a northeast bearing. Anchorage may be obtained in from 6 to 14 fathoms water close to the shore, and a good path from the village crosses the island to Kerawa.

Landing is not always practicable even in the northeast monsoon.

Bompoka Island (native name Poahat), separated from the southeastern part of Teressa by a channel, $1\frac{1}{2}$ miles wide, in which are depths of 30 and 50 fathoms, is $2\frac{3}{4}$ miles in length in a north-northwest and south-southeast direction, $1\frac{1}{2}$ miles in width, 634 feet high, and sparsely wooded; the inhabitants are few.

Anchorage may be obtained at Poahat, on the western side of the island, in a depth of 14 fathoms, about $\frac{1}{4}$ mile offshore, with the village, in line with the north peak of the island, bearing 40° , but the water shoals rapidly, and caution is necessary when anchoring.

Supplies.—Yams, bananas, and papaia may be procured.

Chowra Island (native name Tatat), $6\frac{3}{4}$ miles northwestward of the north point of Teressa, is generally low, but its south end rises almost perpendicularly in a rocky pinnacle to a height of about 343 feet, having the appearance, with the contiguous low portion, of a flap hat, whence it was named Sombrero by the early Portuguese navigators; the natives are morose in disposition, and are disliked by those of the other islands; they manufacture pottery, and the only cooking pots used in the group come from this island.

Reefs are said to extend about $1\frac{1}{2}$ miles from the northwest side of Chowra.

Anchorage.—A village, which has indifferent anchorage off it, is situated on the eastern side of the island.

Anchorage may also be obtained, in from 9 to 10 fathoms water, $\frac{1}{2}$ mile offshore, abreast Sanenya Village, on the northern part of the east coast.

Supplies.—Hogs, poultry, and tropical fruits, especially limes, are obtainable, probably in small quantity.

Tidal streams.—The flood stream in the vicinity of Chowra Island sets northeastward, and the ebb southwestward.

Coral bank.—About $2\frac{1}{4}$ miles northwestward of Chowra is the southern end of a coral bank, with depths of $1\frac{1}{2}$ to $2\frac{3}{4}$ fathoms on it, which occupies a space of about $2\frac{1}{2}$ miles in length in a northeast and southwest direction, and $1\frac{1}{2}$ miles in width, but its limits have not been determined.

Batti Malv Island (native name Et), situated 23 miles north-northwestward of Chowra, is about 150 feet in height, and from a distance appears wedge shaped; it is small, the upper portion thickly wooded, and is without inhabitants. Batti Malv is low near the coast at its northwestern end, whereas on the western, southern, and southeastern sides the rocks descend perpendicularly to the sea.

Reefs appear to extend $\frac{1}{2}$ mile from the northwestern and southwestern sides of the island.

Anchorage.—Indifferent anchorage may be obtained northwestward of the island, but the landing is bad.

Car Nicobar (native name Pu), the northern island of the Nicobar Group, is 8 miles in length in a north and south direction, 7 miles in width, and thickly covered with forest, and the highest ridge in the southwestern part of the island is about 200 feet in height. The northern and northwestern points of the islands should not be approached closely, as foul ground extends from them. Large numbers of coconuts are exported from this island, chiefly to Burma.

Kemios Bay, on the southern side of Car Nicobar, affords anchorage during the northeast monsoon, when the landing is good. Trading vessels anchor in depths of from 10 to 12 fathoms, about midway between the two villages situated on the shore of the bay, which is a convenient position for shipping coconuts.

Tidal streams.—The tidal streams in Kemios Bay are regular and strong; the flood stream sets east-southeast about 3 knots at springs, the ebb in the opposite direction.

East coast.—From Kakana on the southeast side of the island the east coast curves around from the northeastward to north-northwest to Keating Point, the north extreme of the island, a distance of 10 miles; about 4, $4\frac{1}{2}$, and 5 miles from Kakana are Malacca, Perka, and Tamalu Villages, off which anchorage may be obtained in a depth of 14 fathoms $1\frac{1}{2}$ miles from the shore and landing effected in ordinary monsoon weather.

Lapate, about 3 miles north-northwestward of Tamalu, has anchorage in a depth of 12 fathoms, northeastward of the village, and about $\frac{1}{2}$ mile offshore.

Mus, about $\frac{1}{2}$ mile northwestward of Lapate, has anchorage in depths of from 7 to 8 fathoms, with the village bearing 219° , distant 800 yards, but the tidal streams are said to run at a rate of 4 knots at springs and a vessel might drag the anchor.

West coast.—The west coast, from the southwest point of the island, trends in a northerly direction for $5\frac{1}{2}$ miles and then sweeps around Sawi Bay to Keating Point.

Arong, situated $2\frac{1}{4}$ miles northward of the southwest point of the island, affords anchorage in from 9 to 11 fathoms water about $\frac{1}{2}$ mile from the shore; it should be approached with the village bearing east.

Landing is practicable in fine weather, but care is necessary, as the channel between the rocks is only 20 feet wide.

Sawi Bay, on the northwestern side of the island, affords anchorage in a depth of 12 fathoms, over rock, coral, and a thin surface of sand, about $\frac{3}{4}$ mile northward of Sawi Village, and in 7 fathoms water off Observation Spot Point, where there is good landing for boats at low water.

A patch, with apparently a least depth of $5\frac{1}{2}$ fathoms, coral, over it, lies 1,200 yards northwestward of Observation Spot Point.

Village—Water.—The principal village of the island is situated in Sawi Bay. Fresh water, in case of necessity, may be procured at Areka Rivulet, but not without difficulty.

Tides.—It is high water, full and change, in Sawi Bay at 10h. 0m.; springs rise 5 feet. The flood stream runs northeastward.

Tidal streams.—The streams around Car Nicobar are rapid and cause tide races, particularly northward of the island.

About 6 to 8 miles eastward of the island, in the month of February, and the tide being at one-quarter ebb a current or tidal stream, setting southwestward at the rate of 7 knots an hour, was experienced.

Within a few miles of the Nicobar Islands the flood tidal stream generally sets northeastward and the ebb southwestward; the streams attain in the channels between the islands a rate of 3 to 4 knots.

Currents.—In the offing of the Nicobar Islands the current usually sets with prevailing wind, but is variable both in rate and direction; its rate sometimes reaches 50 miles a day.

Ten Degrees Channel, about 77 miles in width, separates Car Nicobar and Little Andaman Islands; it is deep and clear. The tenth parallel of north latitude passes through it near its center.

Andaman Islands extend for a distance of 229 miles in a north-and-south direction, with an extreme width of 32 miles, and are said to number 204. The main part of the group is a chain of five chief

islands, so close to each other and overlapping that they are considered as one, and named Great Andaman. Little Andaman Island is the southernmost and Table Islet the northernmost of the group, which is fully described in Chapter I.

The whole of the Andaman group lies 1' 15'' farther eastward than charted.

Little Andaman Island, named Egu Belong by the inhabitants, who are of the Onges Tribe, is well wooded, and about 600 feet high in the center. From a distance the island appears nearly level, rising gradually from both ends toward its summit.

West coast.—The west coast appears to be fringed by a coral reef, with a sandy beach from Sandy Point, its southwestern point, nearly to Jackson Creek, 16 miles northward; it then trends northeastward 10 miles to the northern point of the island.

Jackson Creek, a small bay into which a stream runs, can be distinguished by a conspicuous square block of trees that falls abruptly to the water's edge. A reef appears to extend northward for $\frac{3}{4}$ mile from the western point of the bay, and there is said to be anchorage inside the end of the reef. Just southward of Jackson Creek the coast is cliffy, and on the northeastern side of the bay there are some remarkable cliffy sandstone islands, hollowed with caves.

Bumila Creek, on the north side of the island, and so named from the flies which infest it, can not be recognized until close off the river, which then shows as a gap in the trees, the land being quite low at the north end of Little Andaman. A coral reef, on which the sea generally breaks, stretches nearly across the entrance to Bumila Creek; the channel, around the west end of this reef, has from 7 to 8 feet in it at low water.

Anchorage.—The anchorage, in a depth of 8 fathoms, over dead coral, about 800 yards northward of the entrance, with the center of the river bearing 157° , should be approached from the northwestward, in which direction the water is clear; off the northeastern coast of the island toward the Brothers there are irregular shallow soundings.

Tidal streams.—The streams set about east by north and southwest at the anchorage off Bumila Creek, and there is sometimes a strong ebb stream out of the creek.

Dalrymple Bank, nearly circular and about 7 miles in diameter within the 20-fathom contour line, lies with its center about 9 miles westward of Sandy Point, Little Andaman. The general depths on this bank are from 13 to 18 fathoms, over broken dead coral, but near the center there are ridges of rock with as little as $5\frac{1}{2}$ fathoms over them. Possibly less depths may exist, and the bank should not be crossed, especially in the southwest monsoon, when there are

heavy rollers on it. There are depths of over 30 fathoms at 3 to 4 miles westward of the shoal center.

South Sentinel, $17\frac{1}{2}$ miles in a west-northwest direction from Bumila Creek entrance, is a small uninhabited level-topped island with a low point on its southern side; the summit of the trees on it is 144 feet high, and it has much the same appearance on all bearings. It is separated from Little Andaman by deep water, and stands on a bank which trends 6 miles northwestward of it, with depths of 11 to 19 fathoms, over coral, surrounded by deeper water.

Anchorage.—The western side is the most shelving, and anchorage can be obtained, in a depth of 14 fathoms, about $\frac{3}{4}$ mile 281° from the center of the island, with the extremes of the island subtending an angle not greater than 35° . Turtle are plentiful here, and there are great numbers of the robber crab.

Landing.—There are practically no shoals outside the fringing reef which surrounds the island; landing can only be effected on its northern side, and in fine weather.

Rock.—In 1899 the master of the steam vessel *Onipenta* reported striking a sunken rock or wreck about 15 miles eastward of South Sentinel, when South Brother Island bore 118° , distant 8 miles.

The Brothers (native name of the north island, Detale, and of the south Egu-china-koi), two small flat-topped islands, lying $4\frac{1}{2}$ and 9 miles northeastward of the northeast side of Little Andaman, are wooded, the summits of the trees on both being about 90 feet high; and each has a lagoon in the middle, the water in which is very brackish and unfit to drink, except during a heavy fall of rain. Numbers of gray pigeons breed on South Brother.

A reef surrounds North Brother and extends about $\frac{1}{2}$ mile northwestward of it; and between the two islands is Leeboard Ledge, a detached shoal, the position of which is approximate. The passage between the Brothers should not be used for navigation.

A reef is situated southeastward, and another, awash and generally breaking, lies about $1\frac{1}{4}$ miles north-northwestward of South Brother, with foul ground between, which also extends 5 miles west-northwestward from the island.

Between South Brother and Little Andaman the channel is $4\frac{1}{2}$ miles wide, but Ariel Ledge, a detached reef, occupies its center, narrowing the channel considerably, and the soundings are so irregular that the passage should not be used.

Duncan Passage, $9\frac{1}{2}$ miles in width, between North Brother and Sisters Islands, is the main channel between Little and South Andaman Islands; it is unsurveyed, and a shoal, the depth on and extent of which is uncertain, has been reported $2\frac{1}{2}$ miles northeastward of North Brother, but the general depths in the channel are believed to

be from 12 to 20 fathoms, over sand, so anchorage might be obtained if necessary.

Directions.—In light breezes and fine weather the tidal streams set eastward and westward in Duncan Passage, but sometimes a current caused by the winds runs through it. In the northeast monsoon, on both sides of the Andaman Islands, the current sets southwestward or southward and in the southwest monsoon northward to eastward. A sailing vessel, in making Duncan Passage, should therefore keep a little northward in the northeast and southward during the southwest monsoon, so as to preserve a leading wind through the channel.

To clear the foul ground northwestward of South Brother, North Brother should not bear eastward of 101° , while the eastern extreme of Little Andaman Island bears southward of 157° ; the position of the rock reported by the *Onipenta* should also be given a wide berth.

The Sisters, two small islands, the eastern 306 feet and the western 232 feet in height, lie close together on the northern side of Duncan Passage, on a bank with depths of from 5 to 12 fathoms, over coral, and the 100-fathom contour line passes about 1 mile eastward of them; a rocky spit extends 1,400 yards northwestward of the ledge connecting the two islands.

The native name of the eastern island is Takoa-te and of the western island Te-joma-de.

Passage Island (native name Chogada), $3\frac{1}{2}$ miles northwestward of the Sisters, is $\frac{3}{4}$ mile in length in a north and south direction and $\frac{1}{4}$ mile in width; its north end, 351 feet high, is rounded, but the south end is low.

A detached rock, 6 feet high, lies about 600 yards northward, and a bank having from 6 to 10 fathoms water over it is situated about 2 miles west-southwestward from the island; the latter consists of a narrow rocky ridge fringed with sand, with overfalls over it at spring tides.

The channel between Passage Island and South Cinque Island is 3 miles wide and clear; it has an average depth of 28 fathoms, but there are tide rips at springs.

Cinque Islands, two hilly narrow islands, almost joined by a rocky ledge, awash at high water, are moderately high and extend in a north-northeast and south-southwest direction for about 6 miles. The trees on both islands are most remarkably contorted by the southwest monsoon.

South Cinque Island (native name Ga-o-ta-koi) is 545 feet high and has a conical knoll 410 feet high at its southern end.

North Cinque Island (native name Gue-a-lue) has two summits, 529 feet and 569 feet high, forming a saddle near its northern end;

and at its south end is a small, conical, bare hill, 293 feet high, from which a promontory projects westward.

Anchorage.—There are depths of from 7 to 10 fathoms, over dead coral and sand, with the west point of the north island bearing 349° , and westward of the sunken ledge joining the islands, and this is the only place around the islands where anchorage can be obtained.

Tides.—It is high water, full and change, at Cinque Islands at 9 h. 47 m.; springs rise 7 feet, neaps $4\frac{1}{2}$ feet.

Manners Strait, between Cinque Islands and Rutland Island, is 3 miles in breadth and has depths of from 18 to 40 fathoms in mid-channel; there are usually tide rips across it. This passage is used by steamers and, with a leading wind, is preferable to Duncan Passage for sailing ships.

Rutland Island (native name Ga-tin-a-koi), on the northern side of Manners Strait, is $10\frac{1}{2}$ miles long in a north and south direction, and about 4 to $6\frac{1}{2}$ miles broad; the southern part of the island reaches a height of 744 feet, and the northern part is high, culminating in Fords Peak (Kalapahar), a peak 1,422 feet above the sea. The northern and southern parts of the island are joined by a low neck of land formed by two bays.

The island is densely wooded; access to it is difficult, and the natives are most hostile.

Portman Bay is a deep indentation on the east coast, having a mangrove swamp and shallow water at its head and irregular deep soundings in the center; a considerable swell sets into it in the north-east monsoon.

Wood-Mason Bay, on the west coast, has its northern part filled with reef, but its southern part appears to be clear of shoals.

Bank.—A bank of dead coral, extending about 5 miles in a north and south direction, and from $3\frac{1}{2}$ to $4\frac{1}{2}$ miles in width, with a depth of not less than 6 fathoms over it, lies with its center $6\frac{1}{2}$ miles south-westward of the south-western point of Rutland Island and is quite safe to pass over in ordinary weather.

Investigator Rock, with a depth of 3 fathoms over it and nearly always marked by tide rips, lies 1,800 yards south-southwestward of the south extreme of Rutland Island; depths of under 10 fathoms extend about 1,200 yards southward of the rock and 400 yards east and west, and a patch of $4\frac{1}{2}$ fathoms lies about 600 yards northeastward of the rock.

As rocks and irregular patches extend some distance off the south coast of Rutland Island, it should not be approached within $1\frac{1}{2}$ miles, except on the eastern part, where it is clear to $\frac{1}{2}$ mile.

The Twins are two level-topped wooded islets on the northern side of a bank, with depths under 10 fathoms, which extends $3\frac{1}{2}$ miles

westward of the southwest side of Rutland Island, from which East Twin, 144 feet high, is distant $1\frac{1}{2}$ miles, and the West Twin (Tekouta) 2 miles in a westerly direction, both islets being situated on a reef.

A rocky ledge extends about $\frac{3}{4}$ mile southwestward from West Twin, and at its extreme is Turtle Rock, which is only covered at high water; this ledge continues to the southward for a similar distance and has on it a patch with a least depth of $1\frac{1}{2}$ fathoms.

Labyrinth Islands, 14 in number, are all rocky and fringed with coral reefs; on their seaward face coral reefs project nearly 1 mile, large blocks of which are broken off by the sea during the southwest monsoon and are thrown on the reefs, appearing like rocky boulders. The channels between the islands are nearly full of coral heads, but the passage between Malaytapu and Jolly Boys Island, the two southeastern islands, leading to the western end of Macpherson Strait, is navigable with proper caution.

Western approach to Macpherson Strait.—**Jolly Boys Island**, 149 feet high, lies $\frac{3}{4}$ mile northwestward of the northern part of Rutland Island; coral reefs, which are generally visible, extend around the island, and for 1,400 yards southwestward and 400 yards westward and northwestward of it.

Boat Island, $1\frac{1}{2}$ miles long, $\frac{1}{2}$ mile broad, and 199 feet high, is the southwestern of the group, and a coral reef projects 1 mile southward from it. Natives resort to this island for fishing.

Tides.—It is high water, full and change, on the northeastern side of Boat Island at 9h. 24 m.; springs rise $6\frac{1}{2}$ feet, neaps $3\frac{1}{2}$ feet.

Malaytapu, nearly 1 mile north-northwestward of Jolly Boys Island, has a rounded summit at its north end, 282 feet high; a rocky ledge extends $\frac{1}{4}$ mile off its south point.

Hobday Island, close northeastward of Malaytapu, has a rocky ledge extending off it for $\frac{1}{2}$ mile toward the north point of Jolly Boys Island, and from the end of the ledge a ridge with depths of from $3\frac{1}{2}$ to $4\frac{1}{2}$ fathoms continues $\frac{1}{2}$ mile farther southward.

Pluto Island, 162 feet high, small and rounded, lies $\frac{1}{2}$ mile eastward of Hobday Island, and is useful as a leading mark.

Dangers.—**Brooker Rock**, a pinnacle of rock with 5 feet over it at low water, lies 1,700 yards south-southwestward of the south point of Malaytapu; there are depths of 5 to 14 fathoms close around this rock, which is usually obscured by the discoloration of the water.

Beauchamp Patch, a small coral head awash at low water springs, 700 yards north-northeastward of the north point of Jolly Boys Island, is not often visible owing to the discoloration of the water.

Peck Shoals are a cluster of coral heads lying northeastward of Beauchamp Patch and on the northern side of the channel into Macpherson Strait.

Macpherson Strait, between Rutland Island and South Andaman Island, is 8 miles in length, with a least navigable width of about 400 yards, and a least depth of about $4\frac{1}{2}$ fathoms between its western and eastern entrances, the former being narrow and much blocked by coral reefs.

Although both shores of the strait are fringed with coral reef, the edges of which in places show above water, that portion of it between the northeast side of Rutland Island and the southwest side of South Andaman Island is clear, excepting a ledge of rocks which projects 1,200 yards east-northeastward from Rutland Island abreast Chiriyatapu, and can always be distinguished.

Chiriyatapu, the eastern entrance point, is a conspicuous bare promontory, 219 feet high, under which are some caves in which edible birds' nests are found, and $\frac{1}{2}$ mile westward of the point is a rock, 1 foot above high water, with deep water westward of it; the passage between the rock and the point should not be used.

Anchorage.—There is anchorage in depths of from 6 to 10 fathoms in the northern part of the eastern portion of the strait with Chiriyatapu Point bearing 125° , distant $1\frac{1}{2}$ miles.

Directions from westward.—When at least 5 miles off the entrance of the strait bring Jolly Boys Island to bear 51° and steer toward it on that bearing until Pluto Island is open one-third of its length eastward of the southeast side of Hobday Island bearing 34° , which mark leads southeastward of Brooker Rock. Steer 34° with the above mark on, passing about 500 yards westward of Jolly Boys Reef, which is generally visible, and about that distance off Brooker Rock by not bringing Pluto Island any nearer to the southeast side of Hobday Island.

When Jolly Boys Island summit is abeam alter course to 45° until the south extreme of Boat Island is just open southward of the south extreme of Malaytapu bearing 265° , and then steer 85° with this mark on astern, which leads between Peck Shoals and Beauchamp Patch, and to the entrance of the strait, through which keep in mid-channel, observing that the western entrance shut in by the northern shore of the strait, bearing 292° , leads northward of the ledge extending from the northeast side of Rutland Island.

The least depths passed over in the above route are from 4 to $4\frac{1}{2}$ fathoms.

Tidal streams.—The tidal swirls are not strong in the vicinity of Brooker Rock and Beauchamp Patch, and the tidal stream is rapid only in the narrows northward of the islet which marks the western entrance point of the strait. The flood stream sets eastward, and the ebb westward, the streams turning at high and low water.

North Sentinel Island, nearly 4 miles square, is about 15 miles westward of Labyrinth Islands, the channel between being clear,

with depths of from 23 to 52 fathoms, over ooze. This island is 400 feet high, thickly wooded, and has a level ridge, which slopes to a very low northwest point. The natives are timid and hostile, and the island is seldom visited by Europeans.

A coral reef nearly surrounds the island, extending from the shore for distances of from $\frac{1}{2}$ to $\frac{3}{4}$ mile, and the lagoons inside the reef have depths of from 3 to 8 feet. No dangers exist outside the reefs, and the 100-fathoms contour line passes 3 miles westward of the island.

There are only two good entrances through the reefs, one on the west coast, just southward of a small islet; the other, and better, on the southern side of the island, eastward of a small islet, and about $\frac{3}{4}$ mile westward of Constance Islet, at the southeastern corner of the island.

Anchorage may be obtained in a depth of 12 fathoms about $\frac{1}{2}$ mile off the second of the two entrances.

Invisible Bank, about 36 miles in length in a north and south direction, and 9 miles in greatest width, lies about 45 miles eastward of Duncan Passage. Near the center of the bank there is an area about 10 miles in length, with depths under 20 fathoms, outside which the depths vary from 23 to 92 fathoms, and the water over it does not appear discolored.

Flat Rock, awash at high water and about 30 yards in diameter, is situated on Invisible Bank, about 15 miles from its south end. There is a depth of 7 fathoms nearly 1 mile southward, and of 6 fathoms $2\frac{1}{2}$ miles northward of the rock.

Caution.—Vessels in the vicinity of Flat Rock should use the lead constantly.

Barren Island, nearly 50 miles north-northeastward of the north extreme of Invisible Bank, is a volcanic island 1,158 feet high and 2 miles in diameter. There are no dangers around the island $\frac{1}{2}$ mile distant. The crater, near the center of the island, is old and choked, its outer slope being covered with foliage. On the western side, the crater wall is broken down and permits a view of the interior, and a thin column of steam issues from a sulphur bed on the side and near the summit of the cone.

Anchorage.—There is anchorage in about 15 fathoms water 400 yards off a beach on the southwestern side of the island, and here the tidal stream at half flood has been observed running southeastward at a rate of $2\frac{1}{2}$ knots, the vessel being kept continually swinging around the anchor on the ebb.

Landing may be effected in a nook formed by an outflow of lava through the gap in the crater wall; a hot spring, the temperature of which has been found to be 110° F., trickles through the beach near the landing place.

Water.—There is no water on the island in the dry season except the hot spring, the water of which is just palatable when cooled. The island is infested by rats.

Narcondam Island, an extinct volcano, 2,330 feet high, in the shape of a truncated cone, has several small rocks above water lying close around it, outside which there appears to be deep water. There is said to be anchorage 200 yards westward of a large rock on the north-northwestern side of the island, which also forms some shelter for landing.

Landing on the island is difficult and dangerous except during the calm weather of February and March; Barata Bay, on its eastern side, where there is a shingle beach, and in very calm weather no surf, is the best landing place, but there is no anchorage. The bay may be known by the groves of palm trees (*Caryota sobolifera*).

South Andaman Island, on the northern side of Macpherson Strait, is $45\frac{1}{2}$ miles in length in a north and south direction and from $2\frac{1}{2}$ to 16 miles in width. Ports Blair and Meadows are situated on its eastern side and Ports Mouat and Campbell on its western side.

East coast.—The east coast of South Andaman Island from Chiriyatapu Point, at the northern side of the entrance of Macpherson Strait, northward to abreast Sesostris Shoal, a distance of 11 miles, is bold and clear to the fringing reef which extends off about 600 yards in places. The 100-fathom contour line approaches this coast to about a distance of 2 miles.

Port Blair is an excellent harbor and the headquarters of the representative of the Indian Government at the Andaman and Nicobar Islands. A Government penal settlement was established at Port Blair in 1858.

Vessels are not allowed to visit Port Blair for commercial purposes, except under Government contracts, and in order to visit and trade at the Nicobars a permit must be obtained from Port Blair.

Tea, coffee, cocoa, paddy, Indian corn, and vegetables are cultivated. The edible bird's-nests are now a Government monopoly.

The port has two outer entrances, formed by Ross Island, and an inner entrance 1,700 yards wide, between Atalanta and Perseverance Points, from which it extends westward for about 2 miles, and then southward for a similar distance to Navy Bay; from Navy Bay it extends as a shallow inlet past Viper Island to Flat Bay at the head, and on both shores from the entrance to its head there are several indentations.

Sesostris Shoal consists of two coral patches, the outer of which, lying $\frac{1}{2}$ mile offshore and 1,800 yards southeastward from South Point, has a least depth of 13 feet over it; the inner patch, about 200 yards southwestward of the outer, has 12 feet water over it.

Buoy.—A conical buoy, painted black, is moored in 8 fathoms water on the eastern edge of the shoal.

Ross Island.—South Point, on the north side of which is a pier, is the southwestern point of the south entrance to the port; the south point of Ross Island, 800 yards northeastward of it, forming the other point. The island is 1,400 yards in length in a north-northeast and south-southwest direction, 600 yards in greatest width at its center and about 195 feet high.

At its north end is the barracks, a dark stone building with battlements about 56 feet high, southwestward of which, on the highest part of the island, is Government House, approached by a road leading from a wooden pier on the western side.

Excepting at the center of its western side, the island is surrounded by a fringing reef.

Lights.—From a wooden structure 56 feet in height on the northeastern corner of the barracks at the north end of Ross Island, is exhibited, at an elevation of 163 feet above high water, a fixed white light, visible 12 miles.

Two fixed red lights are shown from the end of the wooden pier at the western point of Ross Island.

Shoal.—A shoal extends about $\frac{1}{4}$ mile northwestward of the pier on the western side of Ross Island.

Buoys.—Two conical buoys, painted black, each in a depth of 7 fathoms, are moored one at the northern and the other at the western extreme of the shoal.

A mooring buoy, painted black and white in checkers, for the Government vessel stationed at Andamans, lies nearly 300 yards southwestward of the pier end.

Atalanta Point, about 1,600 yards northwestward of South Point, has a cellular jail on it which is very conspicuous. A reef surrounds the point for a distance of about 200 yards.

Beacon.—A white iron latticework beacon, surmounted by a staff and ball, and elevated 12 feet, is erected on the reef extending from this point.

Caution.—The jail must not be mistaken for the barracks on Command Point, when entering by South Entrance.

Sesostri Bay, between South and Atalanta Points, is nearly filled with reefs; an 18-foot patch lies on the line joining the points, and 600 yards from Atalanta Point. Two piers form a boat harbor in the bay.

Fixed red and green lights are shown from the piers in Sesostri Bay.

Radio station.—Four masts, each 150 feet high on the southern shore of Sesostri Bay, are for radio telegraph purposes.

The station is open from 7 a. m. to 4 p. m. on week days, and from 8 a. m. to 9 a. m. and 5 p. m. to 6 p. m. on Sundays. Weather signals are sent out. The station only communicates with vessels when in distress.

The call letters are VTP.

Range lights.—From a white wooden building situated on South Point, a fixed white light is exhibited at an elevation of 49 feet above high water.

About 200 yards 349° from the preceding, from a tower 7 feet in height, painted white, situated on the end of South Point Pier, is exhibited a fixed white light at an elevation of 7 feet above high water.

These lights in line, bearing 169° , lead through the northern part of the south entrance.

On the higher part of Atalanta Point, about 600 yards from its extreme, a fixed red light is exhibited, at an elevation of 144 feet above high water, from a tower 7 feet in height, painted white.

About 300 yards 35° from the preceding, a fixed red light is exhibited, at an elevation of 70 feet above high water, from a tower 7 feet in height, painted white.

These two lights in line, bearing 215° , lead through the northern entrance.

Outer anchorage.—Anchorage may be obtained westward of Ross Island, in a depth of about 50 feet, over sand, and from 200 to 400 yards southwestward of the jetty; this anchorage is not a very safe one in bad weather.

Entrances.—The south entrance, between South and Atalanta Points on the west and Ross Island on the east, is about $\frac{1}{2}$ mile wide between the shoals which fringe both sides.

The northern entrance, between the north point of Ross Island on the south and North and Perseverance Points on the north, is about $\frac{3}{4}$ mile in width between the 5-fathom contour lines.

Depths.—The least depth in the southern channel on the line of the leading mark is 31 feet, and on a similar mark for the northern channel 21 fathoms; the depths at the anchorage in the port are from 36 to 50 feet.

South shore.—**Phoenix Bay**, a small inlet about 1,600 yards westward of Atalanta Point, is used for repairing boats.

Blair Reef, extending 800 yards northeastward from the western entrance point of Phoenix Bay, is rocky, with some parts of it 2 feet above water.

Buoy.—A buoy, pointed black, is moored northward of the northeastern extreme of the reef.

Clearing mark.—Shore Point open of the eastern extreme of Chatham Island, bearing 293° , leads northward of Blair Reef.

Blair Point, nearly $1\frac{1}{2}$ miles west-northwestward of Atalanta Point, is surrounded by reefs, which extend about 250 yards from it.

Chatham Island, 89 feet high and $\frac{1}{4}$ mile northward of Blair Point, is used for sawmills; it is steep to on its northern side, but its southern side is separated by a narrow shallow passage from the reef surrounding Blair Point.

North shore.—**North Bay**, an arm of the harbor immediately westward of North Point, has a coral reef fringing its shores, extending, on the western side, for nearly 400 yards, and a sand flat dries for about that distance from the head. Perseverance Point, its western entrance point, is 1,600 yards southwestward of North Point.

Command Point, 1 mile west-northwestward of Perseverance Point, is about 171 feet high, and on it are whitewashed barracks, which are not conspicuous. Eastward of the point is Semiramis Bay, where there is a pier and watering place; and westward is Command Bay, on the eastern side of which are coal sheds and piers where large vessels coal alongside. Hope Town is situated on the northeastern side of Command Bay.

Buoys.—Two buoys, painted red, are moored in Command Bay for securing offshore hawsers, as, to keep clear of the fringing reef, vessels must lie about 10 feet from the pier ends, at which distance there is a depth of 30 feet.

Mount Harriet, 1,193 feet high, is situated about $1\frac{1}{2}$ miles inland northward of Semiramis Bay, the land descending rapidly from it to the shore; it is sometimes used as a sanitorium, and a good road leads to it from the pier.

Bamboo Flat Bay, $\frac{1}{2}$ mile west-northwestward of Command Point, extends $\frac{1}{2}$ mile northward; at its head are a foundry, a smithy, and a boat-building shed.

Ranger Flat.—Shore Point, which separates Bamboo Flat Bay from Brigade Creek, lies nearly 1 mile westward of Command Point, and off it Ranger Flat, with from 3 to 18 feet water over a bottom of mud and sand, extends about 600 yards southward and 900 yards eastward.

Clearing mark.—Perseverance Point, in line with the northern extreme of Chatham Island, bearing 84° , leads southward of Ranger Flat.

Brigade Creek extends along the west side of the land at Shore Point and turns to the westward, where it is joined by Stewartganj and other creeks; immediately westward of its entrance is Mangrove Bay, filled with a bank on which are mangroves.

Viper Island.—Dundas Point is $1\frac{1}{2}$ miles southward of Shore Point, and nearly 2 miles southwest of it is Tapping Point, with a bight formed between, in which is Viper Island, covered with build-

ings, including a convict jail and a blanket manufactory. South-westward of Viper Island the harbor is quite shallow.

Navy Bay, eastward of Viper Island, has depths varying from 20 to 25 feet; at its eastern end are sawmills and a rifle range.

Anchorage.—The best anchorage in the harbor is in depths of from 7 to 8 fathoms, over mud, with the north extreme of Chatham Island bearing 68° , the island being distant about $\frac{1}{2}$ mile; here there is complete shelter.

Directions.—Coming from the southward and intending to enter by the south channel, the whitewashed barrack of Command Point, open to the northward of Atalanta Point, bearing 312° , leads north-eastward of Sesostris Shoal and through the southern entrance between South Point and the south extreme of Ross Island, and when the range-light towers on South Point and its pier come in line, bearing 169° , alter course to 349° , with them as a stern mark, which will lead through the northern part of the channel.

If intending to anchor westward of Ross Island, when South Point bears 185° steer 5° for the anchorage.

If using the north channel, pass about $\frac{1}{2}$ mile northward of Ross Island and $\frac{1}{4}$ mile southward of Perseverance Point, midway between it and Blair Reef, observing that Shoal Point, open of northeast extreme of Chatham Island, bearing 293° , leads northward of Blair Shoal, then steer in mid-channel between Chatham Island and Command Point, rounding the northwest end of Chatham Island at a distance of about 200 yards, and steer about 214° for the anchorage.

Tides.—It is high water, full and change, at 9h. 36m.; mean springs rise 6 feet, mean neaps 5 feet.

Port Blair.—The penal settlement centers around the harbor of Port Blair, the administrative headquarters being on Ross Island, and the settlement is divided into two districts and four subdivisions, the whole aim of the treatment being to educate for useful citizenship; every religion in India is represented.

Population.—In 1906 the free population numbered 2,976 and the total of convicts 14,691, including women and children; of the convicts 8,559 were imprisoned for the crime of murder.

In 1906 the total military strength was 517, of which 155 were British; the police military battalion was 595 strong.

Communication.—Steam vessels of the Asiatic Steam Navigation Co. bring mails from Calcutta every four weeks, and also an intermediate mail from Rangoon.

The settlement has eight large and two small steam launches, besides lighters, barges, and boats of all sizes. Steam and animal tram lines are laid in various parts, the latter being chiefly to the forests.

There is a radio station in connection with Rangoon via Table and Diamond Islands, and various parts of the settlement are connected by telephone.

Storm signals are shown at Port Blair.

Coal and supplies.—About 5,000 tons of coal is imported annually by the government; a coal wharf 350 feet in length has a depth of 30 feet alongside. Coaling is carried on by baskets, and 800 tons could be put on board in 24 hours; 9 lighters are also available.

Fresh provisions can be procured from the commissariat, and excellent water is brought alongside in tanks from Hope Town. At Ross Island, water is led down the hillside in pipes to the pier, and can be turned on into a boat alongside, but its quality is not so good as the Hoptown water. There is a small marine store for supplying the settlement steamers.

Repairs.—Nearly every kind of trade is taught, and in the Phoenix Bay workshops a large variety of work is carried out, including repairs to machinery, boilers, pumps, etc., and large castings in brass and iron can be made.

Quarantine.—The port is healthy, as the forest in its immediate vicinity has been cleared. Two barracks are reserved for quarantine accommodation at Perseverance Point.

Hospital.—The general hospital is on Ross Island; all free persons are admitted at fixed fees.

Trade.—The principal export is timber; empties belonging to the Commissariat Department, canes and other jungle produce, edible bird's nests, and bêche de mer; the imports are goods and stores for the settlement, clothing, etc.

Coast.—From North Point the coast trends northward and is bold and straight for about 14 miles to Shoal Bay; the land within it rises to a broken ridge, Koyob, about mid-distance of the length of the ridge, attaining a height of 1,505 feet.

Shoal Bay, a narrow inlet between the hills, extending westward for 3 miles and then southward for 7 miles, is fringed with mangroves, and the hills are clothed with fine forest trees, which are cut for export. There is a depth of 4 fathoms at its entrance, whence it rapidly shoals to 3 fathoms and 1 fathom.

Kyd Island, northward of Shoal Bay, is 780 feet high and rounded; a fringing reef which dries at low-water spring tides, extends for a distance of 700 yards from its southeast point and 400 yards from its northeast extreme.

Kotara Anchorage, the entrance to which is about $\frac{1}{2}$ mile in width, between the north side of Kyd Island and Kotara Point, extends for 1 mile in a westerly direction, and then turns northward for rather more than that distance; at its turn to the northward it is

narrowed to nearly 400 yards between the fringing shoals on either side.

Depths.—The depths are from $4\frac{1}{2}$ to 5 fathoms at the entrance, shoaling to $3\frac{1}{2}$ fathoms $\frac{1}{2}$ mile westward, and then increasing in depth to $4\frac{1}{2}$ and 5 fathoms at the anchorage.

Anchorage for small vessels may be obtained in a depth of about 5 fathoms, over muddy bottom, about $\frac{1}{4}$ mile within the part of the port where it changes its direction to the northward; large vessels can find anchorage off Kotara Point in from 7 to 10 fathoms water.

Port Meadows, about 3 miles northward of Kyd Island, is divided at its entrance into two passages, by Duncan or Entry Island, inside which the port extends 2 miles in a westerly direction and opens out into two considerable sheets of water, in the southern of which there is limited anchorage, nowhere more than $\frac{1}{2}$ mile in breadth. The shores of Port Meadows have coral reefs extending off them, and the surrounding land is generally low, with extensive tracts of mangrove jungle, intersected by creeks, and forming several small islands.

Dangers.—**The Patch**, on which there is a depth of $3\frac{1}{2}$ fathoms, fronts the southern entrance, and is 1,100 yards south-southeastward of the south point of Duncan Island.

Whitehouse Rock, about 100 yards in extent, and on which the least depth is 2 fathoms, with $3\frac{1}{2}$ to 10 fathoms around, is rather more than 1 mile eastward of Wedge Point, and midway between is a shoal with 3 fathoms water over it, surrounded by depths of from $3\frac{3}{4}$ to $4\frac{1}{2}$ fathoms, except on the eastern side, where they are from $5\frac{1}{2}$ to 9 fathoms.

Entrances.—The northeast point of a densely wooded hill, which is separated from the main island by mangroves, forms the southern entrance point. A reef which dries at low-water spring tides extends 800 yards from the southern part of the eastern side of the above hill, but from the northeast extreme it is distant only about 200 yards, and has some rocks which dry from 2 to 6 feet on it.

Duncan or Entry Island, about 600 yards in extent, and 260 feet high, has a reef with rocks on it, one 18 feet high, extending from its southwest side, and the south channel into the port between these is about 200 yards in width.

The northern entrance, between the north side of Duncan Island and Wedge Point, the northern entrance point, is 750 yards wide, but narrowed to 250 yards by a reef extending northward of Duncan Island and Wedge Rock, 12 feet high, southward of Wedge Point, and a fringing reef westward of it.

Depths.—The depths in the southern entrance are from 11 to 18 fathoms, and in the northern entrance 2 fathoms; in the harbor they are from 8 to 9 fathoms

Anchorage may be obtained in from 9 to 10 fathoms water about 450 yards westward of the west point of Duncan Island; there is also anchorage in a depth of 8 fathoms in the center of the southwest part of the port.

Directions.—Steer for the south entrance point bearing 281° , observing that the summit of Duncan Island, bearing 315° , leads $\frac{1}{2}$ mile eastward of The Patch, and when Wedge Point is shut in by Duncan Island, bearing 18° , alter course to keep in mid-channel; at low water the rocks on both sides are uncovered.

Tides.—It is high water, full and change, at Duncan Island at 9h. 30m. (approximate); springs rise from 6 to 8 feet, neaps rise from 4 to 5 feet. From the few tidal observations made during the progress of the survey (1903) it appears that the tide tables for Port Blair are practically correct for Port Meadows.

Coast.—From Wedge Point the coast trends in a northerly direction for $1\frac{1}{2}$ miles to South Point, on the south side of Andaman or Middle Strait, and is fringed by a shore reef which extends for distances of from 200 to 400 yards. Rocks which dry 3 and 4 feet are situated offshore northward of Wedge Point, and a rock, 1 foot high, lies $\frac{1}{2}$ mile southwest of South Point.

Smyth Rock, a pinnacle with a depth of $2\frac{1}{4}$ fathoms over it and from $3\frac{1}{2}$ to 10 fathoms round, lies 1 mile eastward of South Point.

Andaman or Middle Strait (Godam Jura), entered between South and North Points, nearly 2 miles apart, is a channel, about 18 miles in length, separating South Andaman Island from Middle Andaman and Baratang Islands; its general width is from 400 to 600 yards, but this is reduced in places to about 80 yards.

The water is generally deep throughout the narrow part of the strait, but one or two ridges, with a least depth of 3 fathoms, cross it; the bottom throughout is mud and sand.

Orol Kaicha Island, situated about halfway through, where the trend of the strait changes from north and south to east and west, may be passed on either side, but the channel eastward and northward of the island has more moderate curves; near Spike Island, at the western end of the strait, the bottom becomes foul.

A steamer drawing 13 feet has passed through this strait.

Eastern entrance—Dangers.—A ledge of rocks which dry at low water extends for $\frac{1}{2}$ mile northeastward of South Point, and, westward of that point, the coast, for $1\frac{1}{2}$ miles, is fringed by a bank of dead coral, mud, and stones, which extends in places for fully 400 yards.

A small, isolated, rocky ledge, 400 yards in length, in a northwest and southeast direction, 100 yards in breadth, and having a conspicuous rock, 5 feet high, on it, lies $\frac{1}{2}$ mile east-southeastward of North Point.

A shoal about 200 yards in extent, with $1\frac{1}{2}$ fathoms water over it, is situated 800 yards south of North Point, and southwestward of the same point a coral reef, which dries in patches, extends for nearly 1,200 yards from the shore.

Bar—Depths.—The outer edge of the bar, which fronts the entrance, stretches from the extreme of the ledge off South Point to the shore about $1\frac{1}{4}$ miles southwestward of North Point and is from nearly $\frac{1}{2}$ mile to 1 mile in width, with general depths of from $1\frac{1}{4}$ to 2 fathoms over it.

Directions.—Entrance Hill, about 2 miles southwestward of North Point, is a small, conspicuous, conical hill, 100 feet high, immediately over the north inner entrance point, and, bearing 290° , leads northward of the dangers on the south, while the same hill, bearing 256° , leads to the southward of those on the north side.

The deep channel is only 200 yards in width, with shoal water extending from each shore, so that it is necessary to buoy the channel before entering; Entrance Hill, bearing about 270° , appears to lead over the deepest part of the bar, and when at a distance of 800 yards from the hill the course should be altered more to the southward to round the point at a distance of about 400 yards to give the best water.

Tides.—It is high water, full and change, at 9h. 36m.; springs rise from 7 to 8 feet, neaps rise from 4 to 6 feet; neaps range from 1 to 2 feet.

The Archipelago which lies 7 to 18 miles off the east coast of Middle and South Andamans, and is separated from them by Diligent Strait, extends from latitude $11^\circ 46'$ north to latitude $12^\circ 15'$ north and consists of 10 islands.

The islands are all densely wooded, practically uninhabited, except by a few Andamanese, who come over in the fine weather; water can generally be obtained by digging from 3 to 4 feet, and the islands abound in pigs and different kinds of pigeons.

Sir Hugh Rose Island, the southernmost, situated 20 miles east-northeastward of Ross Island, is about $\frac{3}{4}$ mile in length in a north and south direction, 800 yards in width, and densely wooded; the highest part, 240 feet, is on the western side, and at the northeast extreme are conspicuous yellow cliffs, about 80 feet high.

The island is fringed all round by a reef, about 200 yards in width, and outside its eastern edge rocky ground, on which the sea breaks, extends for 200 yards.

Rocky ground, with a depth of $4\frac{1}{2}$ fathoms, extends for 600 yards southwestward of the southwest point and gradually slopes to a depth of 10 fathoms, 1 mile from the point. The southern side of the island should not be approached nearer than about 2 miles, to avoid an irregular-shaped 9-fathom patch, which lies $2\frac{1}{2}$ miles off its southwest point.

The passage between Sir Hugh Rose Island and Neill Island should not be navigated, as the bottom is very uneven with coral heads.

Neill Island, about 2 miles northwestward of Sir Hugh Rose Island, is 465 feet high at its northeastern end, where there are conspicuous white cliffs rising abruptly from the sea; a rock about 20 feet high lies 100 yards off this point.

The southern coast is low, partly bordered with mangroves, and fringed by a reef, on which the sea breaks heavily, extending from the southern point for a distance of 800 yards; a patch nearly 1 mile in length in a northwest and southeast direction, within the 5-fathom contour line, and with a least depth of 3 fathoms over it, lies 1 mile off the southwest coast.

The southwest point, which is steep-to, has cliffs of dark color and about 40 feet high.

The north coast is also fringed with reefs, with some foul ground and detached patches of $4\frac{1}{2}$ and 5 fathoms lying off it to a distance of $\frac{1}{2}$ mile.

Nankauri (Nancowry) Strait, separating Neill and Havelock Islands, has deep water and is safe for navigation, but vessels are advised to keep on the northern side of it to avoid a patch of coral of small extent, with a least depth of 7 fathoms over it.

Havelock Island, the largest of the group and situated $2\frac{1}{2}$ miles northward of Neill Island, is about 11 miles in length, in a north-northwest and opposite direction, and 2 to 5 miles in breadth. High white cliffs, about 90 feet high, form the southern extreme, and Sail Rock, 20 feet high, which is detached from it about 200 yards, has, from some positions, the appearance of a sail.

On the southwestern side are two small bays, and from Golung ma, the southern, a tidal creek has three branches extending in different directions inland.

The island is skirted by a coral reef, which, off the western side, extends about 400 yards, except near the entrance to Golung ma and southward of Yoto, where it is nearly double that distance from the shore; on the northeastern side foul ground stretches out for about 2 miles, and the eastern approach to Tadma Juru requires great caution.

Pilot Reef, on a bank fully 1 mile in length in a north and south direction, within the 5-fathoms contour line, has a least depth of $2\frac{1}{2}$ fathoms over it, which lies 1.2 miles southward of Runnymede Point, the south point of John Lawrence Island.

Vibart Shoal, $1\frac{1}{2}$ miles in length in a north-northeast and opposite direction and 400 yards in width, on which there is a least depth of 9 fathoms, is narrow and steep-to on its eastern side; its northern extreme is situated 6 miles 124° from Runnymede Point.

Tadma Juru, the narrow channel between Havelock and Sir William Peel Islands, has deep water and was much used during the survey.

Directions.—Entering from the southeastward the western extreme of Sir Hugh Rose Island just open off the eastern extreme of Neill Island, bearing 172° , leads eastward of Pilot Reef and the foul ground northeast of Havelock Island, and a 352° course should be steered with this mark astern, until the reef extending south of Runnymede Point is seen, when course may be altered to the westward north of Pilot Reef.

From the westward pass about 400 yards northward of Stowe Point, the north extreme of Havelock Island, steering 90° until about 300 yards off Sir William Peel Island, when course should be altered to 122° , keeping in mid-channel, and when approaching the eastern entrance to the strait, steer 73° toward the reef skirting the southwest coast of John Lawrence Island, westward of Runnymede Point, which reef is steep-to and generally visible; keeping to the southward along its western edge, steering about 146° , will lead northward and eastward of the dangers northeastward of Havelock Island.

Tadma Bay, between the southeast part of Sir William Peel Island, and the southwest side of John Lawrence Island, affords good anchorage and shelter from the northeastward.

Sir William Peel Island (Ta-erema), separated by narrow straits from the surrounding islands, is irregular in shape, low, and thickly fringed with mangroves.

Nicholson Island (Kaichawa erema), narrow and hilly, its northern summit being 390 feet high, is separated from Sir William Peel Island by a channel $\frac{1}{4}$ mile in width, which can be used by launches. The northern and southern points are sharp, white, and conspicuous, with reefs extending off them.

The western side of the island is fringed by a steep-to reef extending from 200 to 400 yards, but from the southern point it stretches off about 600 yards and terminates in a shoal with $1\frac{1}{4}$ fathoms over it; off the northern end there is a depth of $3\frac{1}{4}$ fathoms at a distance of about 700 yards.

Rosamund Shoal, a narrow ledge of coral heads, nearly awash at low water, is about $\frac{1}{2}$ mile in length in a north-northwest and opposite direction, steep-to on its eastern side, and generally very difficult to distinguish; it lies between the south point of Nicholson Island and the northern point of Havelock Island, is $\frac{1}{2}$ mile off Sir William Peel Island, and on the northern side of the western entrance to Tadma Juru; the narrow channel northeastward of the shoal should not be used when entering that strait.

Wilson Island (Boroin-erema) is separated by narrow channels from Nicholson and Sir William Peel Islands on the south, and John

Lawrence Island on the east; it is nearly circular, about $2\frac{1}{2}$ miles in diameter, and the summit, about 1 mile from its northwest point, is 710 feet high. The southern and eastern shores are thickly fringed with mangroves, and foul ground, strewn with coral heads, occupies the bay on the north side of the island.

Two Fathoms Rock lies $1\frac{1}{2}$ miles north-northeastward of the northwestern point of Wilson Island.

Clearing mark.—The northern point of Nicholson Island open of the northwestern point of Wilson Island, bearing 192° , leads $\frac{1}{4}$ mile westward of Two Fathoms Rock.

John Lawrence Island (Parkit-erema) is $7\frac{1}{2}$ miles long in a north and south direction, about 2 miles broad, and about 500 feet high on its western side. Shoals and foul ground extend for about $1\frac{1}{2}$ miles off its northwest coast, and rocky heads lie $\frac{1}{2}$ mile off Briton Point, its northern extreme.

Minerva Ledge, an isolated rocky patch nearly 1 mile in length in a north and south direction and about $\frac{3}{4}$ mile in breadth, within the 10-fathom contour line, lies about $5\frac{1}{2}$ miles east-northeastward of Runnymede Point, the south end of John Lawrence Island, and 4 miles westward of the 100-fathom contour line. The least depth obtained on the ledge in 1907 was $3\frac{3}{4}$ fathoms $4\frac{1}{2}$ miles 160° from the east extreme of Inglis Island.

Kwangtung Strait, separating John Lawrence Island from Henry Lawrence Island, is about 600 yards wide at its narrowest part, but the navigable channel is contracted to about half that width by reefs, and has depths of from 12 to 30 fathoms, the reefs skirting each side showing plainly.

Anchorage, with good shelter from the northeastward, may be obtained, in a depth of 7 fathoms, off a sandy bay, immediately north-westward of Wreck Point.

Henry Lawrence Island (Charka-erema), eastward of John Lawrence Island, from which it is separated by Kwangtung Strait, is $7\frac{3}{4}$ miles long in a north and south direction, and about $3\frac{1}{4}$ miles broad. The western side of this island rises to a ridge 567 feet high, and is bordered by a narrow reef, on which are scattered mangroves.

The eastern side is low, with an irregular coast line, thickly bordered with mangroves, from which a fringing reef extends for a distance of 1 mile in places.

Inglis or East Island (Jail-erema), $\frac{3}{4}$ mile eastward of Henry Lawrence Island, and separated by a channel about 400 yards in breadth, in which the depths are from 6 to 10 fathoms, is about 1 mile in length, $\frac{3}{4}$ mile in breadth, and 190 feet in height.

Off its south and northeast points, small portions of the island have been detached by the sea, and at high water appear as small islets, but

at low water are joined to the island by reef. A reef, which skirts all sides but the northwest, off the northeast point extends for $\frac{1}{2}$ mile; it is steep-to, and terminates in two rocks about 4 feet above high water.

A small, thickly-wooded islet lies on the shore reef on the western side of the strait separating Henry Lawrence and Inglis Islands; at low water the reef extends eastward of it.

Inglis Patches are two patches of coral, the northern with a depth of $3\frac{1}{2}$ fathoms over it; lying $\frac{3}{4}$ mile southward of the south point of Inglis Island, and the southern, on which there is $4\frac{1}{2}$ fathoms, about 1 mile south-southeastward of the other.

Outram Island (Tar-mugu), of irregular shape, is about $3\frac{1}{2}$ miles long in a north and south direction, $2\frac{1}{2}$ miles wide, and 298 feet high on its west coast, just within the southwestern point. Except on the western side it is surrounded by a shore reef, that off South Point prolonged by a shoal on which there is a depth of 2 fathoms, extending for nearly 1 mile to the 5-fathom contour line.

Off the east coast the reef extends generally for a distance of about 600 yards. Both the north and the southwest sides are indented, the former by Outram Harbor, and the latter by a bight which is filled with reefs; shoal water extends $\frac{1}{2}$ mile northeastward of East and West Points of Outram Harbor, and the reef surrounding the latter point has low rocks on it.

Charka Juru, the strait separating Henry Lawrence from Outram Island, is about 700 yards in width between the 5-fathom contour lines, and has depths of from 11 to 29 fathoms. When using this channel care should be taken to avoid the coral heads and shoal water, which extend 1 mile south from South Point of Outram Island, and a mid-channel course will lead through the strait.

Outram Harbor, on the north side of Outram Island, extends nearly $1\frac{1}{2}$ miles in a southerly direction, and is about $\frac{3}{4}$ mile wide, but reefs fringe each side and nearly fill the inner half of the harbor.

Directions.—East and West Points, which form the entrance, have shoal water extending about $\frac{1}{2}$ mile off them, which must be avoided, and when entering keep about $\frac{1}{4}$ mile off the eastern side, anchoring about 700 yards within the entrance, in a depth of 10 fathoms, with the north end of Middle Button Island in line with West Point of Outram Island, bearing 290° .

Tides.—It is high water, full and change, at Ja-lebar, on the northwest coast of Havelock Island, at 9h. 40m.; springs rise about 8 feet.

Tidal streams.—The tidal streams and currents were found to be most irregular during the survey, and to be considerably affected by the prevailing winds. The flood stream appears to set to the eastward through the different straits and channels, and heavy tide rips

were observed through Nankauri Strait, and off the north point of Sir Hugh Rose Island, during a northeast wind.

North Button Island (Chauga len jing), at the northern entrance to Diligent Strait, and $3\frac{1}{4}$ miles northward of West Point of Outram Island, is $\frac{3}{4}$ mile long in an east and west direction, narrow, 207 feet high, and terminates in low, irregular, cliffs at the eastern point, while its western part falls abruptly to a spit of sand covered with trees.

Shoal water extends about 1,800 yards eastward and 600 yards westward from the island, the eastern end of which should not be approached within $1\frac{1}{2}$ miles, and the western end within $\frac{3}{4}$ mile, in those directions.

Anchorage.—The northern side of the island is clear, but the bottom is rocky; there is good anchorage on the southern side close to the fringing reef.

Triangulation position.—On the summit of the cliff on the southern side of North Button Island is a station of the great trigonometrical survey of India, which is marked by a stone with a circle and dot, and is in the position given on the charts.

Shoals.—A shoal about 1,200 yards in extent, with a least depth of 2 fathoms over it, lies 2.2 miles northwestward of the western end of North Button Island.

A shoal $2\frac{1}{2}$ miles in length in an east-northeast and opposite direction and 600 to 1,200 yards in width, on which there are depths of from $2\frac{1}{2}$ to $4\frac{1}{2}$ fathoms, lies with its western end situated about $3\frac{1}{2}$ miles northwestward of the western end of North Button Island.

Middle Button Island (Kaicha wa), 3 miles southwestward of North Button Island, is $\frac{1}{2}$ mile long in a northeast and southwest direction, about 400 yards broad, and 164 feet high; the northern end is clifty, but the southwestern point terminates in a short sand spit, with a few low rocks off it.

A ridge of rocks and shoal water extends 1.4 miles southwestward from the island, and shoals with depths of $2\frac{1}{2}$ to $4\frac{1}{2}$ fathoms extend north-northeastward for a distance of $1\frac{1}{2}$ miles from the northern end of Middle Button Island.

Clearing marks.—The whole of North Button open eastward of Middle Button, bearing 37° , leads eastward of the shoal ground extending southwestward of the latter island.

Anchorage.—There is good anchorage southward of Middle Button Island in a position clear of shoals.

South Button Islet (Agga lod baraij), 3 miles southward of Middle Button Island, is circular in shape, about 200 yards in diameter, 118 feet high, and formed of large rocks steep to all around. A coral patch, with $1\frac{1}{2}$ fathoms water over it, lies 1 mile

146° from South Button Islet; and a rocky head, with $5\frac{1}{2}$ fathoms on it, lies 1 mile eastward of that islet.

Baratang Island, separated from South Andaman Island by Andaman Strait and from Middle Andaman Island by Homfray Strait, is about 15 miles in length in a north and south direction and 3 to 8 miles in breadth. The coast, from the eastern entrance of Andaman Strait, trends north-northeastward for 13 miles and is deeply indented with bays and inlets in which anchorage may be found, except during the southwest monsoon, when there is probably a heavy ground swell. The land is hilly and the coast line is fronted by mangroves, growing on reef.

From a point of Baratang Island about $8\frac{1}{2}$ miles northeastward of Andaman Strait Entrance a chain of islands (of which Strait Island is the southernmost), reefs, and rocks extends northward for about 15 miles. The islands are separated from each other and from Baratang Island by narrow channels; the bays and inlets formed by the islands are full of shoals and intricate, but shelter might possibly be found.

Strait Island, the south point of which is $3\frac{1}{4}$ miles north-northwestward of Wilson Island, is $1\frac{1}{2}$ miles long in a north and south direction, about $\frac{3}{4}$ mile wide, and 380 feet high. Its southern end terminates in a narrow point, with shoals of $2\frac{1}{2}$ to $4\frac{1}{2}$ fathoms extending 800 yards south-southwestward of it.

Foul ground and shoals with depths under 5 fathoms extend 2 miles off the eastern side of Strait Island, and the area between its north end and the southeast side of North Passage Island is shoal; vessels of deep draft should not approach Strait Island on southwesterly bearings within a distance of 3 miles.

Anchorage may be obtained in a depth of 10 fathoms about 700 yards northward of the south point of Strait Island.

Diligent Strait lies between Wilson Island, South Button Island, and Outram Island on the southeast, and Strait Island, Middle and North Button Islands on the northwest; the least water to be passed over in its fairway is 6 fathoms, southeastward of Strait Island.

Directions.—From the southward, steer for Strait Island until the southern side of South Button Islet is in line with the northwestern extreme of Outram Island bearing 55°; keep that mark on until the eastern extreme of Middle Button Island bears 22°, when alter course to pass northwestward of South Button Islet and midway between Middle and North Button Islands and Outram Island.

From the northward, and being about 2 miles eastward of North Button Island, steer to pass $\frac{1}{2}$ mile northwestward and westward of South Button Islet, then bring the southern side of that islet in line with the northwestern extreme of Outram Island, bearing 55°, and steer 235°, using it as a stern mark until the northern point of Nich-

olson Island opens westward of Wilson Island, bearing 192° , when alter course to pass about 1 mile westward of Wilson Island.

Tides.—It is high water, full and change, at Strait Island at 9h. 31m.; springs rise $7\frac{1}{2}$ feet, neaps $5\frac{1}{2}$ feet, and neaps range $3\frac{1}{2}$ feet. It is low water about half an hour later than at Port Blair.

Tidal streams.—In Diligent Strait the tidal streams are weak, but with strong southerly winds there probably is a considerable northerly set in the narrows.

Colebrooke Island (Pich laka chakan), lying nearly 1 mile north-westward of Strait Island, is very irregular in shape, about $2\frac{1}{2}$ miles long in an east and west direction, and 285 feet high at its northwest side; it is separated from Baratang Island by Colebrooke Passage, about 400 yards in width, with depths of from 5 to 8 fathoms except at its northern part, which is shallow.

Anchorage, well sheltered and with good holding ground, has been obtained in a depth of $8\frac{1}{2}$ fathoms at the southern end of Colebrooke Passage, with the southeastern extreme of Colebrooke Island in line with the center of Middle Button Island, bearing 63° ; the space available, with a depth of over 3 fathoms, being about 500 yards in diameter.

North Passage Island (Toba erema), nearly 5 miles in length in a north and south direction, is also very irregular in shape and of varying breadth; it is 492 feet high at its eastern end, and lies about 1,400 yards northward of Strait Island. All the eastern side of this island is foul ground, with coral heads and patches extending from 1 mile to $2\frac{1}{2}$ miles eastward of its southeast side; this uneven ground joins that eastward of Strati Island.

The north point is formed by a narrow promontory, which projects about $1\frac{1}{2}$ miles, and nearly 1 mile westward of, and parallel to it is Balfour Reef, which extends about 1 mile northward of the island; Merk Bay, between these, extends $1\frac{1}{2}$ miles to the southward, has a width of about 1,200 yards for about 1 mile, and depths of from 13 to 15 fathoms.

Nancowry Ledge, nearly $\frac{1}{2}$ mile in length in a north and south direction and with less than 1 fathom water over it, lies $1\frac{1}{2}$ miles northward of the north point of North Passage Island, and is on the extreme of a narrow shoal, with depths under 10 fathoms, which stretches to the southward from Long Island.

Guitar Island (To-le-te-le).—Cape Dalrymple, the south point of Guitar Island, is situated $1\frac{1}{2}$ miles west of the south extreme of Nancowry Ledge, and from it Guitar Island stretches for 1.4 miles in a northerly direction, and is 330 feet high near its northern end.

A fringing reef and foul ground extend about $\frac{1}{4}$ mile from the east side of the island, and a shoal, on which there is a depth of 2 fathoms, lies with its south extreme 1,400 yards in a south-southeast

direction, from Cape Dalrymple, with depths of $3\frac{1}{2}$ and $4\frac{1}{2}$ fathoms, between it and the shore reef. A 5-fathom patch lies about 600 yards farther to the southward.

Round Island, about 200 yards westward of Guitar Island, is 400 yards long, 200 yards broad, and 155 feet high.

Elphinstone Harbor, formed by the northern part of the channel which separates North Passage Island from Baratang Island, is about 2 miles in length in a southerly direction, and in that part not encumbered with reefs or shoals is nearly $\frac{3}{4}$ mile square.

The entrance between Balfour Reef and the northwest point of North Passage Island, on the east, and a detached reef, which lies $\frac{3}{4}$ mile off the northeast end of Baratang Island, on the west side, is about $\frac{1}{2}$ mile in width. A shoal, with a depth of $4\frac{1}{2}$ fathoms over it, lies $\frac{1}{4}$ mile southeastward of the detached reef on the west side of the entrance, and about $\frac{3}{4}$ mile farther south is another detached reef which, with a shoal with a rock awash on it, on the east side of the harbor, contract the width to $\frac{1}{2}$ mile.

Depths.—The depths are about 11 fathoms in mid-channel of the entrance and of the harbor.

Homfray Strait (Chara Juru).—The eastern entrance to Homfray Strait is on the western side of that to Elphinstone Harbor; the outer edge of the bar of the strait, close to the detached shoal already mentioned, is 1,200 yards in width between reefs which project from the mangroves on either side.

Depths.—The bar is about $1\frac{1}{4}$ miles across, with depths of from $1\frac{1}{2}$ to 3 fathoms over it, and within it are depths of from 4 to $5\frac{1}{2}$ fathoms; it is said that there is not less than $2\frac{3}{4}$ fathoms in the strait, after the bar is crossed.

Directions.—No directions are given for Elphinstone Harbor or for the bar of Homfray Strait, but the conspicuous tree, on the hill, 388 feet high, on the north side of the latter, bearing 273° , will probably lead in mid-channel between the north point of North Passage Island and Nancowry Ledge, and bearings of the same tree lead either north or south of the 5-fathom patch in mid-channel between the extreme of Balfour Reef and the shoal southward of Cape Dalrymple.

Entering Elphinstone Harbor, a mid-channel course should be kept between the northwest point of North Passage Island and the detached shoal northeastward of Baratang Island.

Tides.—It is high water, full and change, in Elphinstone Harbor at 10h. 0m.; springs rise from 7 to 8 feet; neaps rise from 5 to 6 feet.

Long Island (Ma-i-tang), nearly $\frac{3}{4}$ mile north-northeastward of Guitar Island, extends for $4\frac{1}{4}$ miles in that direction, from Cape Smith, its south point, and has a general width of 1 mile; it is densely wooded, and 435 feet high at its northwestern side.

Reefs and shoal water extend for about 700 yards, in places, off its south, east, and north sides, but the western coast is joined to Middle Andaman Island by a shallow flat, on which the depths are generally less than 1 fathom.

The channel which divides it from Guitar Island extends, with depths of from $3\frac{1}{2}$ to 7 fathoms, for a distance of $3\frac{1}{2}$ miles in a north-northwestern direction, forming the entrance to several creeks which branch out into Middle Andaman Island.

Osmaston Shoal, situated $1\frac{1}{2}$ miles eastward of Cape Smith, is about 300 yards in length in an east and west direction and 200 yards in width, with $2\frac{1}{2}$ fathoms water over it.

Headlam Patch, nearly circular and about $\frac{1}{2}$ mile in diameter, has a least depth of 2 fathoms, the shoal water surrounding it, with depths under 10 fathoms, being about $\frac{3}{4}$ mile long and $\frac{1}{2}$ mile wide; it lies nearly 3 miles north-northeast of Osmaston Shoal and 1.4 miles off the east side of Long Island.

Anderson Rock, which dries 1 foot, lies 1 mile eastward of the north point of Long Island, on a shoal about 1 mile square, with depths under 10 fathoms.

Campbell Shoal, $5\frac{1}{2}$ miles eastward of the north point of Long Island, is about 400 yards in length in a north and south direction, fully 200 yards in width, with a depth of 3 fathoms over it, and lies on the eastern side of a bank, about $2\frac{1}{2}$ miles in length in a north and south direction, with depths under 20 fathoms.

Rong-at Bay.—A point on Middle Andaman Island 535 feet high, forms the south side of Rong-at Bay, the north entrance point being 290 feet high. These are both bold bluff points; the southern, excepting a reef which extends $\frac{1}{2}$ mile southward of it, is comparatively steep-to, but the northern point has a shoal stretching fully 2 miles eastward of it, with a patch of 4 fathoms near its extreme, and a rock that dries 4 feet $\frac{1}{2}$ mile off the point.

The anchoring space within the points is about 1,200 yards square, with depths of from $3\frac{1}{2}$ to 5 fathoms; inside it expands to 2 miles in width, but is quite shoal with reefs that dry and mangroves.

Coast.—From Rong-at Bay the coast trends for a distance of 13 miles in a northerly direction to Cuthbert Bay, and is high; 3 miles westward of Cuthbert Bay is a peak, 1,678 feet high, and from this the coast, still continuing high, trends rather to the westward of north for 9 miles to Kinserley Point.

Stewart Sound, which lies between Kinserley and Cadell Points, 11 miles apart in a north-northeast and opposite direction, is fronted by Sound Island, which occupies nearly a central position between these points; the sound recedes for a distance of about 6 miles, with several small bays, of which Bacon Bay is the only one recommended for anchorage.

White Mountain, 2 miles westward of Kinserley Point, is 1,184 feet; Ray Hill, on a promontory which forms the western side of Bacon Bay, is 445 feet; and a hill about 2 miles west-northwest of Cadell Point is 720 feet high, and these, with other hills surrounding the sound, are densely covered with jungle. At the head of a shallow bay on the southern side of the sound is the entrance to Austin Strait, separating Middle and North Andaman Islands.

Sound Island, very irregularly shaped, is $4\frac{1}{2}$ miles in length between its south extreme and North Point, and 482 feet high, about 1 mile southwestward of the latter.

Ridges of high land traverse the island in all directions and are prolonged in spurs to the points of the bays which indent it; the coasts are fringed with a belt of mangroves, and surrounded by coral reefs, with occasional sandy beaches.

Square Rock, 14 feet high, and 300 yards southward of the south point of the island, on the reef extending from it, is a useful mark when entering the sound. Jones Point, the southwest extreme of the island, has a reef extending 700 yards southward of it, on which is a ridge of rocks which terminates in one that dries 8 feet; the western side of the point is steep-to.

North Point has rocks extending from it for a distance of 900 yards in a northeast direction.

Landing.—Good landing may be effected in a small sandy bay on the southeast side of the island.

Convict Patch, 1.1 miles northward of Kinserley Point, is 1,400 yards in length in an east and west direction and has rocks on it with less than 1 fathom water over them; its eastern end is about 1.3 miles from the shore westward of it. A 6-fathom patch lies about $1\frac{1}{2}$ miles southeastward of Convict Patch.

Five Fathom Patch, of sand and coral, $\frac{1}{2}$ mile in length in a north and south direction and 600 yards in width, within the 10-fathom contour line, has a least depth of 5 fathoms over it and lies $1\frac{1}{2}$ miles northeastward of Convict Patch.

Aves Island, about 600 yards in extent and 207 feet high, is connected with Aves Point, westward of it, by a coral reef which dries in places at low water, spring tides; the island is easily recognized from seaward.

Kwangtung Point, the southern entrance point to Bacon Bay and the eastern point of the bay, at the head of which is Austin Strait, is 213 feet high; northward and westward of this point is the Berkeley Group of Islands, comprising Orchid, Curlew, Egg, and Dottrel Islands, the three first being 157, 150, and 60 feet high, and lying across the entrance to Bacon Bay.

A shoal with a depth of $2\frac{1}{2}$ fathoms over it, lies 1,400 yards south-southeastward of the southeast point of Orchid Island, and that point

has a reef extending 300 yards from it, but otherwise the island is steep-to.

Marsack Shoal, two small coral patches lying between Jones and Brown Points, are about 700 yards apart, the eastern having a depth of $3\frac{1}{2}$ fathoms, and the western, which is 1,700 yards west-northwestward of Jones Point, a depth of $1\frac{1}{2}$ fathoms over it.

Bacon Bay, about 2 miles in length in a north and south direction and $1\frac{1}{2}$ miles in width, is entered between Orchid Island and Brown Point, the entrance being about $\frac{1}{2}$ mile wide; it forms a large and excellent harbor, completely sheltered from all winds.

Depths.—There are depths of from 11 to 17 fathoms in the entrance, and from 12 to 14 at the anchorage.

Directions.—Approaching Bacon Bay from the southward, Ray Hill should be brought just open of Jones Point, bearing 322° , and steered for until Aves Island bears 265° , when Orchid Island will be seen about midway between Aves Island and Jones Point, and course should be altered for it, and when Aves Island bears 135° steer 315° , with it astern, passing in mid-channel between Orchid Island and Brown Point, and then keeping to the northward for the anchorage at the head of the bay.

Coming from the northward, and intending to enter by the south entrance, Square Rock should be rounded at a distance of 1,200 yards, and when Orchid Island is seen midway between Aves Island and Jones Point, follow the directions given above.

Stewart Island, situated in a shallow bay on the northwest side of Stewart Sound, is $2\frac{1}{2}$ miles in length in a northwest and southeast direction, $1\frac{1}{2}$ miles in breadth; it is covered with dense jungle, and joined to North Andaman Island by a mud bank at low water, spring tides.

Sunk Rock, 2 miles 73° from Monkhouse Point, dries 2 feet and has a patch of 3 fathoms close northwestward of it. A group of rocks, uncovering 8 feet at low water, spring tides, lie $\frac{1}{2}$ mile southwestward of Sunk Rock, and have shoal water extending nearly $\frac{1}{4}$ mile southwestward of them.

Oyster Islet, 4 feet high, is nearly $\frac{3}{4}$ mile southward of Sunk Rock.

Oliver Island, 1 mile westward of north point of South Island, is about 400 yards in extent and 195 feet high; its east and north sides are fringed by a reef, extending 200 yards from the latter, but the southwest part of the island is steep-to, and there is a deep-water channel between it and Sound Island.

Morland Rock, situated 800 yards southwestward of Cadell Point, uncovers 8 feet at low water, spring tides; shoal water, with a depth of $2\frac{1}{2}$ fathoms, extends 600 yards south-southeastward of the rock.

Elfin Patch, a coral shoal 600 yards in length in a northeast and opposite direction, and 200 yards in breadth, has less than 1 fathom water over its center, which is 1 mile southeastward of Cadell Point.

Anchorage may be obtained in almost any part of Stewart Sound, but, as previously stated, Bacon Bay is the only anchorage recommended.

Tides.—It is high water, full and change, in Stewart Sound at 10h. 5m.; springs rise 8 feet, neaps rise 6 feet.

Tidal streams.—The flood stream sets to the northward and the ebb to the southward, attaining a velocity of $1\frac{1}{2}$ knots at springs, in the narrow parts of the Sound. Southward of Camp Bay the flood has a rate of a quarter of a knot, the ebb attaining a velocity of 2 knots.

Water.—Springs of fresh water are situated near the shore of Middle Andaman Island, about 3 miles southward of Aves Island, also at Camp Bay, but only a small quantity can be obtained during the dry season from either of these places, and, at that period, none is obtainable on Sound Island.

North Andaman Island—East coast.—From Cadell Point the east coast of North Andaman Island trends to the northeastward for a distance of 3 miles to Tara Lait, a small bay, and then to the northward for 12 miles to Dundas Point, at the southern side of Port Cornwallis; this coast affords no landing.

Saddle Hill, a mountain 2,402 feet high and the highest part of the Andaman Islands, is situated about 8 miles northward of Cadell Point; Saddle North Peak, 2,247 feet high, lies $2\frac{1}{4}$ miles farther northward; they are covered with vegetation, and on easterly or westerly bearings form two peaks with the appearance of a saddle.

Craggy Island, 9 miles northward of Tara Lait, is small and connected to the shore by a reef, on the southern side of which there is good anchorage in depths of from 4 to 10 fathoms. The land near Craggy Island is apparently thickly populated.

Port Cornwallis, entered between Dundas Point and Bopung Island, extends, with several changes in direction, for 8 miles in a northwest direction; dense belts of mangroves line the shores, and on its southwest side are Atalanta and another bay and on the northeast side Minerva and an unnamed bay. Brush Islet occupies the center of the channel inside the entrance, and Chatham Island is situated on the western side of the port, with North, South, and Wharf Islands northward of it.

Dundas Point, on the south side of the entrance, is a sharp rocky point rising to 426 feet $\frac{1}{2}$ mile southward of its extreme; Middle Reef, awash at high water, is situated $\frac{1}{2}$ mile south-southeastward of the point.

South Reef, awash at high water, is 800 yards eastward of Dundas Point, with shoal patches between and a narrow shoal, steep-to, with depths under 5 fathoms, extends 700 yards northeastward of South Reef.

Bopung Island, connected by a sandy spit with the land eastward of Hood Point, about 600 yards northwestward, is surrounded by a reef, which, with shoal water, extends 900 yards eastward and nearly 600 yards southward of it. North Reef, situated on the edge of the 10-fathom contour line, is awash at high water and lies 750 yards southeastward of the island.

Entrance—Depths.—The entrance between Dundas Point and Bopung Island is 1.4 miles in width, but is narrowed to a little less than 1 mile between the 5-fathom contour lines surrounding the dangers on each side; the depths in the entrance channel are from 10 to 20 fathoms, shoaling to 7 fathoms at the anchorage.

Southwest side—Atalanta Bay.—Rocky Point lies $1\frac{1}{4}$ miles west-northwestward of Dundas Point, with Atalanta Bay between them, in the entrance to which there is good anchorage during the southwest monsoon; a rocky patch of $3\frac{1}{4}$ fathoms lies 1,800 yards westward of Dundas Point in the center of the bay.

Brush Islet, the tops of the trees on which are 51 feet high, is surrounded by a reef and situated nearly in mid-channel $\frac{1}{4}$ mile northward of Rocky Point. A shoal 1,200 yards in length in an east and west direction, with depths under 5 fathoms, has a rock with a depth of 3 feet over it, at its western end, situated nearly 1,800 yards westward of the islet.

A patch with a depth of from 7 to 9 fathoms, over mud, lies nearly 1 mile northward of the islet, on the line of the leading mark.

Chatham Island, the south point of which lies $1\frac{1}{4}$ miles west-northwest of Brush Islet, extends thence northward 1.6 miles, and is from 400 to 800 yards in breadth; it is about 200 feet in height, and covered with jungle.

Northeast side—Perseverance Point.—Hood Point is 800 yards northwest of Bopung Island, with a small shallow bay between, and Perseverance Point, $1\frac{1}{4}$ miles farther in the same direction, is 318 feet high, with depths of 7 to 12 fathoms 200 yards off it.

Minerva Bay, situated between the points, has depths of from 12 to 13 fathoms in the center, but a rocky patch, with from 6 to 8 fathoms over it, extends about 1,400 yards southeastward of Perseverance Point across the entrance of the bay.

Low Islet, about 40 feet high, is situated about 1 mile northward of Perseverance Point.

North Island, $\frac{1}{2}$ mile northward of Chatham Island, is about $\frac{1}{2}$ mile long, in a north and south direction, 300 yards wide, and 277

feet high. Wharf Islet, 159 feet high, and South Islet, 119 feet high, are situated westward of the southern part of North Island.

The western part of the harbor is very shallow, but a narrow channel, with not less than 3 fathoms, passes between Wharf and South Islets, and turns southwestward into an extensive and very shallow backwater, surrounded by mangroves.

Anchorage.—The best anchorage is northeastward of Chatham Island in depths of from 6 to 8 fathoms, over mud.

Directions.—Enter the harbor with South Point, Chatham Island, in line with Brush Islet, bearing 287° , until the western extreme of Wharf Islet is in line with the northern extreme of Chatham Island, bearing 312° , which mark leads up the harbor; when abreast Perseverance Point steer to the northward for the anchorage about midway between Chatham Island and Low Islet.

Tides.—It is high water, full and change, in Port Cornwallis at 9h. 50m.; springs rise 8 feet, neaps $5\frac{1}{2}$ feet; neaps range 3 feet.

Supplies.—A few natives, who are quite friendly, live on the shores of the harbor, and generally bring off fish to a vessel, which they will exchange for tobacco, biscuit, or calico; there are some beds of good oysters. There is an abundance of fresh water, and about 1,200 yards above Perseverance Point is a spring.

Climate.—The climate of the port was supposed to be unhealthy, but there appears reason to doubt this, as, during the survey, a party remained on Chatham Island for a month without any sickness occurring.

Back Bay lies between Bopung Island and Mangrove Point, a bluff point $2\frac{1}{4}$ miles northward.

Back Bay Reef, situated about $1\frac{1}{2}$ miles north-northeastward of the eastern end of Bopung Island, dries 5 feet; except when the sea is very smooth it is generally visible at high water.

One Fathom Shoal, lying 1 mile southeastward of Mangrove Point, is 600 yards in length, in a northeast and southwest direction, and 400 yards in width, within the depths of 10 fathoms; the least depth on the shoal is 1 fathom, and the sea only breaks on it in heavy weather. The 20-fathom contour line passes about $\frac{1}{4}$ mile eastward of the shoal.

Clearing marks.—Hand Peak, a sharp wooded hill, 719 feet high, southwestward of Rocky Point, in line with the southern end of Bopung Island, bearing 234° , leads southeastward of One Fathom Shoal, and Tree Islet in line with Cape Price bearing 340° , leads eastward of it.

Turtle Islands, 2 miles north-northwestward of Mangrove Point, are small, wooded, and 150 feet high; a fringe reef surrounds each of them, and there is a sandy beach on the northern side of the southwestern island. Turtle Reef, with a sand bank 4 feet high in

the middle, lies $\frac{1}{2}$ mile northward of the islands; and a shoal with 4 fathoms water over it lies east-southeastward $\frac{1}{2}$ mile from Turtle Reef.

There is a clear passage, from 600 to 800 yards wide, with a depth of not less than 11 fathoms between Turtle Islands and the main island.

Thararo, a small wooded islet, lies at the entrance of a shallow channel leading to Port Cornwallis; a shelving reef extends 500 yards from its eastern side. A rocky ledge, awash at high water, lies 700 yards eastward of Thararo.

Table Islands are two islands covered with high trees.

Chirume, the southern of these islands, is nearly circular, 1,200 yards in extent and about 200 feet in height; on its eastern and southern sides there are mangroves and on the northwestern a clear sandy beach.

The shore reef extends about 800 yards southward of the island, which lies on the southwest part of a shoal nearly $2\frac{1}{2}$ miles in length in a north and south direction and $1\frac{1}{2}$ miles in width; this shoal extends about $1\frac{1}{2}$ miles eastward of the north end of Chirume Island.

Excelsior, the northern of these islands, lying about $\frac{3}{4}$ mile north-northeastward of Chirume, at the northern part of the shoal just mentioned, is $\frac{1}{2}$ mile long in a northwest and southeast direction, 600 yards broad, and 180 feet high.

The shore reef extends about 600 yards from its northeast side; on its southwestern side there is a sandy beach which is steep-to; both islands are comparatively steep-to on their western sides, but foul ground with dangers extends $1\frac{3}{4}$ miles eastward of them, or to the 10-fathom contour line.

Table and Mushroom Reefs, the most noticeable of these dangers, lie within $\frac{1}{2}$ mile of each other about $1\frac{1}{2}$ miles east-southeastward of Chirume; they dry 4 feet and generally show.

A patch, with $2\frac{1}{2}$ fathoms water over it, lies nearly a mile north-eastward of Excelsior Island.

In passing this vicinity the water should not be shoaled to less than 20 fathoms, that depth being found at about 2 miles from Table Islands.

South Passage Reef, in the southern entrance to the passage between Table Islands and the main island, is small and covered at high water, spring tides, and should be passed on its western side, as shoal water extends 800 yards east-southeastward of it.

North Passage Reef, about $\frac{1}{2}$ mile westward of Excelsior Island, is awash at high water, spring tides, and always shows.

Trilby Island, about 1 mile in length in a north and south direction, $\frac{1}{4}$ mile in width, and 257 feet in height, lies off the eastern

entrance point to Cadell Bay about 1 mile westward of Chirume Island.

Tree Islet, rocky, 45 feet high, with some low trees on it, lies 600 yards east-northeastward of the northern point of Trilby Island, the passage between being foul, with a rock, which dries, in mid-channel. There is a clear passage between Tree Islet and North Passage Reef.

Bond Harbor, southwestward of the south extreme of Trilby Island, is sheltered, except from northward, and affords good anchorage in depths of from 7 to 8 fathoms, over sand and mud, in the middle of the harbor with Tree Point bearing 90° .

Cadell Bay, lying westward of Trilby Island, and a projecting point of North Andaman Island, has good anchorage in depths of from 6 to 7 fathoms, over mud, in the southwest monsoon.

Beauchamp Reef, $1\frac{1}{4}$ miles northwestward of the northern point of Trilby Island, and nearly a mile offshore, is about 600 yards in length in a north and south direction, and is awash.

Coast.—From abreast Beauchamp Reef the coast trends northward for a distance of $7\frac{1}{2}$ miles to Cape Price, and, having several rocky patches lying off it, should not be approached within $2\frac{1}{2}$ miles; good landing may be effected on several parts of this stretch of coast. The most outlying danger is a rock with 3 fathoms water over it, and surrounded by depths of from 4 to 6 fathoms, which lies about $1\frac{1}{4}$ miles offshore 2.6 miles northward of Beauchamp Reef. Two miles farther north, and nearly 1 mile offshore, is a $3\frac{1}{4}$ -fathoms patch.

Pocock Island, $1\frac{1}{2}$ miles southeastward of Cape Price, is 244 feet high and wooded. About $\frac{1}{2}$ mile southward of the island is a rock which dries 4 feet, and the passage inside the island should not be used.

Union Ledge, nearly awash at low water and situated $6\frac{1}{2}$ miles eastward of Pocock Island, forms the southern limit of an extensive bank of soundings with uneven bottom, which extends southeastward of East Island. A patch with from 6 to 8 fathoms water over it lies $\frac{3}{4}$ mile eastward, and a 3-fathoms patch lies about 800 yards southwestward of the ledge.

Cape Price, the northern point of North Andaman Island, is densely wooded and slopes gradually to the sea; from it the coast, which is much indented, densely wooded, and generally fringed with mangroves, trends, with two large indentations, west-southwestward about 7 miles to Cape Thornhill.

One Fathom Patch, lying 1,200 yards northward of Cape Price, is about 400 yards in extent, with $4\frac{1}{2}$ to 6 fathoms between it and the cape; it breaks in heavy weather.

East Island, $2\frac{1}{4}$ miles north-northeastward of Cape Price, is $2\frac{1}{4}$ miles long in a north-northeast and opposite direction 1,300 yards

broad, and 243 feet high. A few oceanic teal frequent the lagoon on this island, which also abounds with the small Andamanese Pig.

Shoals with depths under 5 fathoms extend 2 miles northwestward of the north end of the island.

Tides.—It is high water, full and change, at East Island at 9h. 30m.; springs rise 8 feet, neaps 5 feet; neaps range 3 feet.

Landfall Island, about 1,400 yards westward of East Island and separated from it by a channel with a depth of 3 fathoms, but so narrow as to be only suitable for boats, is $3\frac{1}{2}$ miles long, in a northwest and southeast direction, 2 miles broad, and 260 feet high at its northern end. A few Andamanese, encamped on the island in 1896–1898, were friendly, and brought off fish in exchange for biscuit.

Landfall Rocks, off the southeast end of the island, are 42 feet high, and conspicuous.

Cleugh Passage, between North Andaman Island and East and Landfall Islands, is navigable, but, owing to the numerous shoals in it, for which no clearing marks can be given, and the strong tidal streams, it should not be used. The general depths in the passage are from 11 to 31 fathoms, but several patches, with from $5\frac{1}{4}$ to 10 fathoms water over them, are scattered all over it.

Cleugh Rocks, about $1\frac{1}{2}$ miles south-southwestward of the southwestern point of Landfall Island, form a reef, $\frac{1}{2}$ mile long in an east and west direction, and about 600 yards broad, the western part of which, awash at high-water springs, is visible; there are depths of from $2\frac{3}{4}$ to 9 fathoms around the rocks.

Passage Rock, about $\frac{1}{2}$ mile southeastward of Cleugh Rocks and nearly in the middle of the passage, is small and dries 4 feet; there is deep water around it.

The passages northward of Cleugh Rocks, or between them and Passage Rock, should not be attempted.

Tidal streams.—In Cleugh Passage the flood stream sets about east-southeast and the ebb west-northwest, the rate at springs being about $1\frac{1}{2}$ knots. Tide rips occur over nearly the whole of the passage.

Jackson Ledge, on which the least depth found was $1\frac{1}{2}$ fathoms, is $\frac{1}{4}$ mile long in a northwest and southeast direction, and rather over 200 yards wide, and situated $3\frac{1}{4}$ miles eastward of the northeastern point of East Island; tide rips occur in its vicinity, but it has not been seen to break.

Ranger Reef, with a least depth of 1 fathom over it, is about 200 yards in extent, and lies 2 miles eastward of the northeastern point of East Island, with 5-fathom patches $\frac{1}{2}$ and $\frac{3}{4}$ mile northward of it. The sea breaks on the reef in heavy weather, but it can not be seen, even from aloft, at other times; tide rips occur in its vicinity, and between it and the northern point of East Island.

Hickman Shoal.—An area of shoal water, with depths under 10 fathoms, extends $1\frac{1}{2}$ miles north of the north end, and $2\frac{1}{2}$ miles north and northwest of the northwest extreme of Landfall Island; Hickman Shoal, near its northwest extreme, consists of two patches of $4\frac{1}{2}$ and $4\frac{3}{4}$ fathoms, the southern and shoaler being $1\frac{1}{2}$ miles northward of the northwestern end of the island.

Between Hickman Shoal and the island, and eastward of the shoal, are several patches with depths of from $2\frac{3}{4}$ to $5\frac{1}{2}$ fathoms.

West Island. $1\frac{1}{2}$ miles long in a north-northeast and opposite direction, $\frac{3}{4}$ mile broad, 178 feet high, and thickly wooded, is fringed by a reef and shoal which extends from 600 to 700 yards from the northwest and north sides, respectively, and a shoal of $4\frac{1}{2}$ fathoms lies $\frac{1}{2}$ mile southward of its southern end, which is situated about 3 miles northwestward of Cape Thornhill, with deep water between. The north and south ends of the island should not be approached to a less distance than 1 mile.

Thornhill Island, separated from Cape Thornhill by a channel 200 yards in width, with a depth of $2\frac{1}{2}$ fathoms in it, is nearly circular, 800 yards in diameter, and 254 feet high. A reef, with rocks on it 3 feet high, lies 1,400 yards northeastward of Thornhill Island, and the same distance offshore.

Whitecliff Island, 110 feet high, lying $1\frac{1}{2}$ miles westward of Thornhill Island, with deep water between, is 700 yards long in a north-northwest and opposite direction, 500 yards broad, and its northern end has cliffs 60 feet high, dark in color; except at this part it is surrounded by a reef, extending 400 yards round its southern part; the island should not be approached nearer than $\frac{1}{2}$ mile.

Caution.—Although the shoals about the northern end of the Andaman Islands have been examined, there is a possibility that less water may exist over them than has been found and is shown on the chart; also the shoals are not always visible from aloft, and vessels should not attempt to pass over any shoal shown on the chart in this locality.

West coast.—The west coast of the Andaman Islands has coral reefs more extensive and extending to a far greater distance from the land than those on the east coast, shoal patches being found at distances of from 20 to 25 miles from the land. The highest land of the Andaman Islands, which consist of hills covered with luxuriant vegetation, is on the eastern side, and gradually descends toward the western side, where marshy localities abound.

The western side of the islands is exposed to the southwest monsoon, in which season especially it should not be approached, and at any time it is by no means a desirable locality.

Mountains and hills.—The most conspicuous summits between Cape Thornhill and Shark Islet are: Taylor Hill, 644 feet high, a

long ill-defined summit $6\frac{1}{2}$ miles south-southeastward of Cape Thornhill.

D'Oyley Peak, 522 feet high, very sharp, 8 miles south of Cape Thornhill.

Tuson Hill, 790 feet high, three summits of nearly the same height and only a slight dip between them.

Tradikeli Hill, 1,110 feet high, a sharp ridge with a peak at its southern end, 17 miles southward of Cape Thornhill and eastward of Casuarina Bay.

Saddle North Peak, 2,247 feet high, a flat top with a sharp peak at its northern end, 23 miles southward of Cape Price.

Saddle Hill, 2,402 feet high, a rounded summit, about $2\frac{1}{2}$ miles southward of Saddle North Peak; all the above are some distance from the west coast. The following coast hills are noticeable: Brown's Hill, 300 feet high, about a mile southeastward of Cape Thornhill; Jessop Hill, 440 feet high; and Lowis Hill, 360 feet high, all of which have two summits; and Bluff Point, 230 feet high, with an irregular summit.

Coral Banks.—West Coral, Middle, and South Banks are three great banks, composed of dead coral and sand, with some bunches of live coral, on the western side of the Andaman Islands; the water over these banks is very clear, and, judging from the appearance of the bottom, it seems probable that the rollers break on Middle Bank in the southwest monsoon, though they may not do so on the other banks.

West Coral Bank, the northernmost, is 26 miles in length in a north-northeast and south-southwest direction, $3\frac{1}{2}$ miles in breadth, and lies from 9 to 18 miles off the west coast of North Andaman, the shoalest part, with a depth of 6 fathoms, over rocky bottom, being 29 miles westward of Saddle North Peak.

Middle Bank, $10\frac{1}{2}$ miles in length in a north and south direction, within the 25-fathom contour, $5\frac{1}{2}$ miles in width, and oval shaped, lies about 16 miles westward of Middle Andaman Island; the least depth, $3\frac{1}{4}$ fathoms, where the rocky strata, which forms the ridge from which these banks rise, crops up for a few yards through the dead coral and sand, is situated 15 miles westward of Flat Island.

South Bank is irregular in shape, about 9 miles in length in a north and south direction, and 8 miles in greatest breadth, has a least depth of 6 fathoms near its center, which is situated 16 miles westward of the west side of Spike Island.

The 100-fathom contour passes close westward of the banks, and the increase of swell generally indicates their vicinity.

In the northeast monsoon they may be safely passed over, but a vessel of much draft must not cross the shoaler places. The navigation inside the banks to within 3 miles of the land is safe, except on

the western side of North Andaman, to which a berth of 5 miles should be given.

Aspect.—From the center of West Coral Bank, Saddle Hill is the highest visible land, and southward of it the hills fall rapidly, and only a few hummocks show above the horizon as far as White Mountain, 1,184 feet high, which is isolated and situated $3\frac{1}{2}$ miles westward of Kinserley Point, on the south side of Stewart Sound.

East Coast Hill may be seen a little farther southward in very clear weather, and, from a less distance, North Reef Island and Interview Island appear, the latter having a long level-topped ridge.

From Middle Bank, Saddle Hill is well above the horizon, but seldom visible. White Mountain, bearing 56° , appears whale-backed, and a peak 703 feet high situated 6 miles eastward of the southern end of Interview Island just shows to the left of it. Southward of White Mountain is East Coast Hill, a high range, with a sharp peak on the right slope of the highest part. West Coast Range of Middle Andaman Island stretches from about 79° to 113° , and the land falls low at the southern extreme of the range in the vicinity of the Middle Strait.

From South Bank, White Mountain is the northernmost land visible in clear weather: farther southward is East Coast Peak, high, but very faint, with West Coast Peak and range close to the right of it; this range terminates at Spike Island, the latter showing a small tuft at its northern end. Southward of Spike Island the land continues low, with an occasional small peak until it rises to the high range eastward of Port Campbell.

Coast.—From Cape Thornhill to Bluff Point, a distance of 4 miles, the coast trends southwestward, and is much indented.

Bluff Point, on the eastern side of the northern entrance to Temple Sound, is 230 feet high, clifly, bold in appearance, and from the southern entrance to Temple Sound it shows three summits.

Reef Island (Boa-pong), $1\frac{1}{2}$ miles southward of Whitecliff Island, is 1,400 yards long in a north and south direction, 800 yards broad, low, but covered with trees, the tops of which are 140 feet above the sea. A fringing reef surrounds the island except on its eastern side, and shoal water extends 1,800 yards southwestward of it. Irregular soundings of 5 to 9 fathoms extend 2.4 miles west-southwest of the southwest extreme of the island.

Temple Sound, between Paget and Point Islands, on the northwest, and Shearme Island, on the east side, affords good anchorage, sheltered from all but southwesterly winds. The bottom in the sound is very uneven, and caution is necessary both in entering and anchoring, the plan being the best guide.

Paget Island (Chopta-luk), $3\frac{1}{2}$ miles south-southwestward of Reef Island, is $1\frac{1}{2}$ miles long in a northeast and southwest direction,

1½ miles broad, 250 feet high to the top of the trees, but slightly elevated in places, and, owing to the way the trees have grown, it makes as a flat island; the southeast side is formed of cliffs 100 feet high.

Except on its eastern side it is surrounded by a fringing reef, which, with a shoal, extends for ¾ mile northward of the north point.

Point Island (Kora tharpit), southward of Paget Island and separated from it by a channel nearly 400 yards broad, is 1 mile long in a north and south direction, 600 yards broad, and covered with trees, the tops of which are 150 feet high; it is almost entirely fringed by a reef on which are mangroves around the southern and eastern sides, the reef and shoal water within a depth of 5 fathoms extending 1,400 yards from the southwest side, and a detached reef and shoal 1½ miles from the northwest point.

Sugar Loaf Islet, 600 yards offshore, on the southeast side of the entrance to Temple Sound, is a noticeable conical rock, 65 feet high.

Bolton Shoal, lying nearly in mid-channel of the entrance to the sound between the south point of Point Island and Sugar Loaf, has a least depth of 5 fathoms over it, is nearly circular, and 700 yards in diameter within the 10-fathom contour line.

A shoal, with depths of from 5½ to 9 fathoms, extends 1,800 yards south-southeastward from the south end of Point Island, and nearly joins Bolton Shoal.

Anchorage.—The anchorage, in from 10 to 12 fathoms water, over mud and sand, is in the center of the head of the Sound about ½ mile southward of Paget Island.

Tides.—It is high water, full and change, in Temple Sound at 9h. 10m.; springs rise 8 feet, neaps 5 feet.

Coast.—The west coast of North Andaman Island, trending southward from abreast Paget and Point Islands, for about 30 miles, to the western entrance of Austin Strait, the narrow strait which separates North and Middle Andamans, is strewn with islands and reefs, for the position of which the chart is the best guide.

Mackey Bank, 3¼ miles southwestward of the southern point of Point Island, is about 2 square miles in extent, and has depths of 4 to 8 fathoms on it; vessels should pass outside this bank.

Hudson and Casuarina Bays, situated 6 and 9 miles, respectively, southward of Point Island, are both shallow.

Shark Islet, 3¼ miles off the coast, southwestward of Casuarina Bay, is a small sandy islet 100 yards in extent, covered with bushes 20 feet high, and surrounded for a distance of 200 yards by a coral reef, on which are some rocks above water. Vessels should pass outside the islet.

North Reef Island (Tala murgu), nearly 3 miles in length in a north-northwest and opposite direction, and 1½ miles in breadth, is a

low, flat wooded marshy island, $6\frac{1}{2}$ miles southward of Shark Islet; a reef projects nearly 2 miles off its south point. Austen Islet, a small wooded sandstone islet, lies off the northeastern point of North Reef Island, with a channel between them; it is narrowed by a spit.

Anchorage.—There is a good anchorage in depths of from $6\frac{1}{2}$ to 9 fathoms about $1\frac{1}{4}$ miles eastward of North Reef Island; in approaching from the northwestward, round Austen Islet at a distance of 800 yards to clear a $3\frac{1}{4}$ -fathom shoal lying $1\frac{1}{2}$ miles northward of Austen Islet, and also a spit extending about 600 yards southward of that islet.

Interview Island (Tauteramiku) is 13 miles long in a north and south direction, and 3 miles broad, and its north point, which lies $4\frac{1}{4}$ miles southward of the south point of North Reef Island, is low, rising gradually to 370 feet high, where it is level topped and wooded; the south point terminates in a cliff, close off which is a rocky pinnacle 22 feet high. Reefs and shoal water extend 2 miles off the north and 3 miles off the south points of the island.

Austin Strait, which divides North and Middle Andaman Islands, is entered eastward of the middle of Interview Island.

South Reef Islet, small and woody, lies 1 mile southwestward of the south point of Interview Island, and a stony bank of 3 fathoms extends $2\frac{1}{4}$ miles southeastward of the islet.

Port Andaman, the channel eastward of South Reef Islet, has muddy water and very irregular soundings over rocky bottom at its entrance; this locality is dangerous, and the channel should be considered unnavigable until it has been surveyed.

Tuft Island, about 6 miles south-southeastward of the south point of Interview Island, is a sand bank about 10 feet high. The large bay northeastward of Tuft Island is encumbered by reefs and unfit for anchorage.

Coast.—The west coast of Middle Andaman Island from abreast Tuft Island trends southward for a distance of about 23 miles to the western entrance of Andaman Strait, and appears bold and precipitous. Hump Island lies about $\frac{3}{4}$ mile off this coast 3 miles southward of Tuft Island, and Flat Island about 1 mile off the coast 9 miles southward of Tuft Island. A 6-fathom patch is situated 4 miles southwestward of Hump Island.

Andaman Strait—Port Anson.—The southwest coast of Middle Andaman Island, which forms the northern side of the northern entrance to Andaman Strait and Port Anson, trends in a southeast direction for a distance of 2 miles; immediately south of the northwest part is Foul Bay, filled with reef, and a reef extends 300 yards off this coast in places to Brook Point, within which is a rounded knoll 316 feet high.

Dangers.—A shoal about $\frac{1}{2}$ mile in width extends for a distance of 1,700 yards within the 10-fathom contour line from the west point of Foul Bay and has on it a rock with less than 1 fathom water over it distant 200 yards, and Half Tide rock, which dries 3 feet, distant $\frac{1}{2}$ mile from its south extreme; there are also rocks awash and shoals with depths of from 2 to $3\frac{1}{2}$ fathoms on different parts of it.

Spike Island (Tao boroga), the northern side of which, between Breaker and Steep Points, 1 mile apart, forms the south side of the entrance to the strait and port, is $\frac{1}{2}$ miles in length in the form of an isosceles triangle, with its apex to the southward; the southern entrance to the strait and port is southward of this island, but, although deep, it is dangerous.

Spike Island is 448 feet high at its northern and 309 feet at its southern end and is densely covered with jungle. The northern side has a narrow fringing reef and shoal water extending off it for nearly 400 yards, and on the western side the island has a fringing reef extending off 350 yards in places; shoal water stretches 600 yards northwestward of Breaker Point and 700 yards from the west side of the island, about 1 mile southward of that point. Rocks from 1 foot to 6 feet high stand on the edge of the reef fringing the western side, and of these Long Rock and Cinque Rocks are about midway of the length of the island.

Braganza Ledge, on the south side of the entrance, has a depth of $4\frac{1}{2}$ fathoms over it and is situated nearly $\frac{1}{2}$ mile northwestward of Breaker Point.

Taylor Patches, about 1 mile in length, in a north and south direction, within the 10-fathom contour line, have a least depth of $4\frac{1}{2}$ fathoms, which is situated $1\frac{1}{2}$ miles southwest of Breaker Point.

Entrance—Depths.—The northern entrance, which is $1\frac{1}{2}$ miles in width between the west point of Foul Bay and Breaker Point, is narrowed to about $\frac{1}{2}$ mile by the shoal southward of Half Tide Rock and Braganza Ledge and retaining that width for about $\frac{3}{4}$ mile, then narrows to 350 yards between the fringing reefs and shoals off Brook and Steep Points; the depths in the outer part of the entrance are from 13 to 17 fathoms, increasing to from 22 to 40 fathoms farther in. The depths in Port Anson are from 9 to 11 fathoms.

Port Anson is about $2\frac{1}{2}$ miles in length in a north and south direction and 1,400 yards in width, and the eastern side of Spike Island, which forms its western side, is comparatively steep-to in places, but has some islets and reefs which dry off it; Stoat, Mangrove, and Tala Kaicha Islands, forming the eastern side of the port, have fringing reefs and a detached reef lies $\frac{1}{2}$ mile westward of the northern end of the latter island.

In the southern part of the port Whales and other reefs extend for 1,200 yards in a north and south direction, and 400 yards westward

of the southern end of Tala Kaicha Island is a reef about 700 yards long in a north and south direction, the northern end of which is always above water.

Stoat Island, about 1,400 yards long in a north and south direction, 250 yards wide, and 140 feet high, has a very narrow fringing reef on its western side, which extends 200 yards off the north and south points; its northern point is 1,600 yards eastward of Steep Point. The entrance to Homfray Strait is northward of Stoat Island.

Mangrove Island, 700 yards southward of Stoat Island, is about $\frac{1}{2}$ mile long in a north-northeast and opposite direction, and has a reef extending nearly 400 yards off its western side.

Tala Kaicha Island, $2\frac{1}{4}$ miles in length and overlapping the two preceding islands to the eastward, is about 800 yards wide and 330 feet high.

Whales Reef, nearly circular and 350 yards in diameter, dries in patches at low-water spring tides, and lies 1,400 yards northward of the south point of Tala Kaicha Island; it and the two reefs lying about 400 and 800 yards, respectively, to the southward of it are generally, but not always, visible.

Directions—Port Anson.—From the westward, approach with the low mangrove north point of Stoat Island just open of Brook Point, bearing 112° , and when about $\frac{1}{4}$ mile from that point keep in mid-channel, and, rounding Steep Point, the northeastern point of Spike Island, steer to the southward and anchor in depths of from 9 to 10 fathoms, over muddy bottom.

Through Andaman Strait.—If proceeding through Andaman Strait, steer to the southward in mid-channel in Port Anson until abreast the southern end of Mangrove Island, when edge eastward until the apex of a fine conical peak to the northward opens just in sight eastward of the nearer hills which form the western side of a large mangrove valley bearing 3° , when steer 183° , using it as a stern mark, which leads between the ledge of rocks, 400 yards northward of the south end of Tala Kaicha Island, and Whales Reef and the reefs southward of it.

When the south extreme of Tala Kaicha Island bears 90° steer about 220° for the south point of Spike Island, giving the northwestern side of a narrow promontory, on the port hand, a berth of about 600 yards, and avoiding the reefs off the southern part of Spike Island, and steer southward on the western side of the sound.

When the island with two small hillocks on it, at the western end of the narrows, bears about 113° , steer to pass southward of it, and continue in mid-channel through the straits.

At spring tides do not attempt to pass through the narrows during the strength of the tidal stream, which is slack at the times of high

and low water at Port Blair; at neaps the streams are scarcely felt.

Tides.—It is high water, full and change, at the south point of Spike Island, at 9h. 25m.; springs rise 7 feet, neaps 5 feet.

Homfray Strait (Chara Juru), between Middle Andaman and Baratang Islands, is about 11 miles in length, intricate, and rocky, but the depths in the fairway are not less than $2\frac{1}{2}$ fathoms until nearing the eastern entrance, where there is a broad bar on which there is apparently a depth of $1\frac{1}{2}$ fathoms, over sand and gravel. The narrowest part of this strait is about 60 yards in width, and the bamboo grows plentifully on its banks. The tidal streams are strong with many eddies.

West coast.—**Cape Bluff**, the northern point of South Andaman Island, is 287 feet high, clifty, with a reef distance around it; Bluff Island, 800 yards in length in a north-northwest and opposite direction, 400 yards in breadth, and wooded, the tops of the trees being about 100 feet high, lies $\frac{1}{4}$ mile northward of the cape.

A reef extends 600 yards westward and 1,000 yards northward of Bluff Island, leaving a very narrow channel with a least depth of $1\frac{1}{2}$ fathoms between the cape and the island, and a deep but narrow and intricate passage between the cape and island and Spike Island.

From Cape Bluff the west coast of South Andaman Island trends southward for about 17 miles to Petrie Islet, on the northern side of the entrance to Port Campbell; there are no known off-lying rocks or shoals on this coast.

Port Campbell, nearly $2\frac{1}{2}$ miles in length in a north and south direction, from $\frac{1}{2}$ mile to $1\frac{1}{4}$ miles in width, is a fine harbor, with anchorage in depths of from 6 to 12 fathoms, over a bottom of ooze; the shelter within is perfect, as the port is almost landlocked, but, owing to the narrow entrance, it is not easy of access to sailing vessels. In the vicinity of the port the cliffs are of yellowish gray sandstone, in which the strata lines show very plainly.

Petrie Islet, on the northern side of the entrance, is connected by shallow water with the northwest point of an island about 3 miles in length in a north-northwest and opposite direction, which partly forms the eastern side of the port.

Montgomery Islet, on the southern side of the entrance, is connected to the entrance point on that side by rocks, and from it the western side of the port has a general south-southeast direction to its head.

Dangers.—A shoal extends for $\frac{1}{2}$ mile in a southerly direction from Petrie Islet, and another from the middle of the western side of the island, to which Petrie Island is connected; the latter extends in a southwesterly direction for more than a mile into the port, has a breadth of about $\frac{1}{2}$ mile, and on it are some rocks awash.

A shoal stretches in a northeast direction from the west side of the port, nearly 1 mile southward of Montgomery Islet, for a distance of 1 mile, and has from 2 to 3 fathoms water near its extreme.

Entrance—Depths.—The entrance to the port between Petrie and Montgomery Islets is about $1\frac{1}{2}$ miles in width, but is narrowed to 1,600 yards between the extremes of the shoals above mentioned, and within is further reduced to $\frac{1}{4}$ mile between their edges.

A shallow patch with from 5 to $6\frac{1}{2}$ fathoms lies in the entrance, but otherwise the depths are from 9 to 16 fathoms, with from 9 to 12 fathoms at the anchorages.

Anchorage.—There is anchorage in about 12 fathoms water at the entrance, about 1,600 yards northeastward of Montgomery Islet, and, in a similar depth, in the center of the port about 1.1 miles southeastward of the same island; several other anchorages are charted.

Village.—A native village is situated on the main island near Montgomery Islet; water and wood are abundant.

Tides.—It is high water, full and change, in Port Campbell at 8h. 26m.; springs rise 6 feet.

West coast.—From Montgomery Islet the west coast of South Andaman Island continues south-southwestward and southward for 15 miles to Palmer Point; it is very little known, and appears to have several salient points fringed with coral reefs.

Constance Bay, eastward of Palmer Point, is shoal, with several islets and reefs in it. A large rock above water lies on the southern edge of the reef at about 1 mile southward of Palmer Point, and a rocky bank with $3\frac{1}{4}$ to 8 fathoms over it extends $1\frac{1}{4}$ miles westward and 2 miles south-southwestward of the rock.

Tarmugli Island, the northwestern island of the Labyrinth Group, lies with Frederick Point, its northern end, situated $5\frac{1}{2}$ miles south-southwestward of Palmer Point, whence it extends southward 3 miles, with a breadth of about 2 miles; it is 257 feet in height, and its southwestern point is cliffy, with two rocks, 15 feet high, close off it.

A continuous reef fringes its northern side with a large area of foul ground extending $2\frac{1}{2}$ miles northward and inclosing Allen Patches, a part of which is awash at low water, spring tides; it is separated from the shoal water off Palmer Point by a channel of clear water about 1,400 yards wide.

An irregular reef, with off-lying patches, borders the western side of the island for a distance of $1\frac{1}{4}$ miles.

Currents.—On the western side of the Labyrinth Islands in the fine season the surface current runs southward, but it occasionally reverses for periods of about 24 hours.

Port Mouat, northeastward of Tarmulgi Island and nearly abreast Port Blair on the eastern coast, extends eastward for about $1\frac{1}{2}$ miles from the entrance between Perseus and Andromeda Points to the narrow entrance to a nearly circular basin, about $\frac{1}{2}$ mile in diameter.

About 1 mile eastward of the entrance the harbor contracts to a width of 300 yards and the navigable channel to little more than 100 yards.

Perseus Point, on the north side of the entrance, consists of low wooded hills, the tops of the trees being about 100 feet high, and from it the southern edge of a reef, on which are rocks awash and drying, extend $1\frac{1}{2}$ miles in a west-southwest direction to the 10-fathom contour, which, near its extreme, incloses Hooper Patch, with from 2 to $2\frac{1}{2}$ fathoms water over it.

A flat, with rocks and a sandy spit on it, extends for a distance of 600 yards southward of Perseus Point and the land for 800 yards eastward of it. A shoal, with rocks at its extreme, on which there is a depth of less than 1 fathom, extends $\frac{3}{4}$ mile westward of Andromeda Point on the south side of the entrance, and northward of the point a somewhat similar flat to that on the northern side borders the shore, extending off $\frac{1}{2}$ mile.

Two patches with a depth of $2\frac{1}{2}$ fathoms over them lie in the center of the channel between the edges of these flats.

Entrance—Depths.—The entrance, between the flats extending from each entrance point, is about 600 yards in width, but the $2\frac{1}{2}$ -fathom patches in the center narrow it to 200 yards either northward or southward of them; inside these the general breadth is about 600 yards for $\frac{3}{4}$ mile, when shoals from each inner entrance point contract the channel to 200 yards, and between these points it has only a width of 100 yards.

The depths are from 7 to 10 fathoms either north or south of the $2\frac{1}{2}$ -fathom patches, decreasing to 7 fathoms till in the inner entrance, when they are from 11 to 20 fathoms, shoaling to $5\frac{1}{2}$ and $4\frac{1}{2}$ fathoms in the basin.

Directions.—With the western side of Tarmugli Island bearing eastward of south, bring Perseus Point to bear 101° and steer for it on that bearing, which leads between the shoal ground southward of Palmer Point and the northern end of Allen Patches, and when Grub Island, 144 feet high, small, and with a high yellow cliff, is in line with Fords Peak, Rutland Island, bearing 159° , steer with this mark on which leads between Allen and Hooper Patches.

The northern inner entrance point of Port Mouat bearing 86° leads between the northern edge of the flat extending northward of Andromeda Point and the $2\frac{1}{2}$ -fathom patches in mid-channel, but the plan of Port Mouat should be used with caution until the locality

has been resurveyed, and before entering it would be advisable to buoy the $2\frac{1}{2}$ -fathom patches.

Tides.—It is high water, full and change, at Port Mouat at 8h. 40m.; springs rise 5 feet.

Coco Channel, between Landfall Island, the northern of the Andaman Islands, and Little Coco Island, is 21 miles broad, contracted to about 17 miles by Daphne Rock and South Patch; southward of these dangers, for a distance of about 6 miles, the depths are from 20 to 52 fathoms, but between that and Landfall Island they are from 8 to 25 fathoms, the bottom being coral, with occasional sand and mud patches and somewhat irregular in the southern portion. A patch of 10 fathoms is situated about 9 miles north-eastward of East Island, and the strong tidal streams cause a heavy sea over this shoal in bad weather.

Currents.—During the northeast monsoon the current frequently sets northwestward through Coco Channel; but in the southwest monsoon its direction is mostly to the eastward.

Tidal streams.—In Coco Channel during settled weather there are regular tidal streams, the flood setting eastward and the ebb westward at rates of from 1 knot to 2 knots at springs. The streams are much influenced and frequently even reversed by strong winds.

Tide rips occur in the vicinity of all shoal water in the Coco Channel.

Caution.—The northern end of the Andaman Islands should not be approached nearer than 4 miles, nor the southern end of Little Coco Island nearer than 5 miles.

Coco Group consists of three islands, Little Coco, Great Coco, and Table Islands; the southern point of Little Coco, the southern of the group, lies $21\frac{1}{2}$ miles north-northeastward of the eastern point of Landfall Island. They are included in the Hanthawaddy District of Burma.

Little Coco Island, 2.6 miles in length in a north and south direction, and $\frac{3}{4}$ mile in greatest width, is densely wooded, and 247 feet high in its center; it is surrounded by a belt of coconut trees, and there is a lagoon at its southern end, but the water is not drinkable. There are a few wild pigs on the island.

The island is surrounded by a coral reef, which extends only a short distance from its eastern and western sides, but $\frac{1}{2}$ mile around the north end of the island with irregular soundings for more than 1 mile northward of its edge, and the same distance from the southwest point, and foul and uneven ground continues for 4 miles southward of the island.

Anchorage.—During easterly winds there is good anchorage in depths of from 9 to 12 fathoms, over sand and mud, with smooth water, in Lambert Bay on the western side of the island. The water

there shoals gradually; on the eastern side of the island the bottom is rocky and foul.

South Patch, of coral, on which 7 fathoms was the least depth found, but on which there may be less water, lies $3\frac{1}{2}$ miles southward of the south point of Little Coco Island; vessels should pass southward of this patch.

Daphne Rock, a small coral patch with a depth of $2\frac{1}{2}$ fathoms over it, lies $2\frac{1}{2}$ miles southward of the south point of Little Coco.

Middle Rock, with less than 1 fathom water over it, lies 2 miles southward of the same point, between which and Middle Rock the ground is uneven, with rocky patches awash situated 1,200 yards southward of the island.

Investigator Patch, on which there is a least depth of $1\frac{1}{2}$ fathoms, is an area of shoal and rocky ground, nearly circular, and about $1\frac{1}{2}$ miles in diameter, lying 2 miles east-southeastward from the south point of Little Coco.

Alexandra Channel, separating Little Coco and Great Coco Islands, is $7\frac{1}{4}$ miles in width between the 10-fathom contour on either side, and has depths of less than 20 fathoms on the western side for a distance of 3 miles from Little Coco Island, but on the eastern side the depths are from 31 to 37 fathoms.

Great Coco Island, $5\frac{1}{4}$ miles in length in a north and south direction, and 1.1 miles greatest breadth, lies $8\frac{1}{4}$ miles northeastward of Little Coco Island; it rises very steeply, with a few bare patches on its western side, and slopes gradually eastward, where it is densely wooded; it is 366 feet high near both extremes.

A reef projects 1 mile southward of the south point, with Jerry Islet, 97 feet high and wooded, near its extremity, from which rocky and uneven ground stretches to the southward for nearly 2 miles, the southern side of which should not be approached within 1 mile.

There are no outlying dangers, but rocky and foul ground extends 800 yards from its northwestern and 400 yards from its northern points.

Pechee Point, on the eastern side of Great Coco Island, 1 mile southeastward from its north point, is a bluff 150 feet high, surmounted by a few trees, and connected with the mainland by a low neck. Binnacle Rock, about 14 feet high, is situated on the extreme of a reef which extends 600 yards northeastward in Pollok Bay; it is 800 yards west-northwestward of Pechee Point.

Rat Islet, about 1 mile southward of Pechee Point, is 125 feet high, small, and wooded, with reefs extending 400 yards eastward, and others connecting it with the mainland.

Ford Bay, between Pechee Point and Rat Islet, affords good sheltered anchorage, with strong westerly winds, in depths of from 7 to 10

fathoms, over sand and mud, with Rat Islet bearing 183° , distant about 1,200 yards.

Supplies.—There are a number of wild cattle on Great Coco, but it is difficult to shoot them, as the jungle is almost impenetrable. A belt of coconut trees surrounds the island, and there is a small fresh-water lagoon on the low neck connecting Pechee Point with the island.

Marshall Channel, separating Great Coco Island from Table and Slipper Islands to the northward, is 1,300 yards in width between the 5-fathom contour of those islands, and has depths of from $5\frac{1}{2}$ to 9 fathoms.

Table Island, about 1,600 yards long in a north and south direction, 1,200 yards wide, 146 feet high, and densely wooded, except on its southwestern side, presents a flat, level surface with steep sides on all bearings.

Slipper Island, 400 yards northwestward of Table Island, and connected to it by a reef that dries, is about 500 yards long in an east and west direction, 200 yards wide, 113 feet high; it is covered with grass, with a few trees near the summit. A remarkable pillar rock is situated near its western extreme.

The surrounding reef projects $\frac{3}{4}$ mile northwestward from Slipper Island, $\frac{1}{2}$ mile northeastward from the north point of Table Island, and 700 yards southward from the south point of that island. A $6\frac{1}{2}$ -fathom patch lies 1.3 miles northeastward of Table Island, and irregular soundings, causing tide ripples and swirls, extend $4\frac{1}{2}$ miles east-northeastward of the island.

Caution.—Besides the irregular soundings, the tidal streams in this locality are strong, and often set on the rocks; vessels should therefore keep well to the northward of Table Island.

A gun is kept on Table Island for the purpose of warning vessels when appearing to pass too close to the reefs off the island.

Light.—A cylindrical tower, 91 feet in height and painted red and white in horizontal bands, on a grassy ridge at the southwestern and highest part of Table Island, exhibits, at an elevation of 195 feet above high water, a group flashing white light visible 20 miles. (For details see Light List.)

Anchorage.—Anchorage in the northeast monsoon may be obtained in a depth of 10 fathoms, over rock, in Table Bay on the southwest side of the island, with the lighthouse bearing 11° about 600 yards offshore; but care should be exercised when anchoring so as not to be too close to the reef nor so far out as to be in the strength of the tidal stream.

During the southwest monsoon the anchorage is in from 9 to 12 fathoms water, over sand and rock, on the northern side of the

island, with the lighthouse bearing 180° about 800 yards offshore, but this position is exposed.

Landing.—The landing place, on the southwest side of the island, on the rocks immediately under the lighthouse, is not convenient, but is better at high than low water.

On the north side of the island the landing place, marked by stakes on the reef, is bad and dangerous, except in fine weather; the state of the landing, whether landing is dangerous or not, is indicated to a vessel anchoring by the lightkeeper.

Supplies.—There are a number of wild cattle on Table Island, but they are not easily shot; a few coconuts can be obtained, but the supply of vegetables and water is only sufficient for the lightkeeper's use.

Radio station.—A radio station is established on this island.

It is open to the general public from 7 a. m. to 4 p. m. on week days and from 8 a. m. to 9 a. m. and 5 p. m. to 6 p. m. on Sundays.

The call letters are VTT.

Signals.—Weather signals and storm signals are exhibited from a flagstaff on Slipper Island.

Tides.—It is high water, full and change, at Table Island at 9h. 53m.; springs rise $8\frac{1}{4}$ feet, neaps $5\frac{3}{4}$ feet, and neaps range $2\frac{3}{4}$ feet.

Tidal streams.—The flood stream runs eastward, the ebb westward; and in settled weather the streams appear to turn at high and low water. The rate of the tidal streams is upward of 5 knots in Marshall Channel and about 2 knots past the north and south ends of Little Coco.

Even in fine weather there are heavy tide races off all the salient points, especially at both ends of Little Coco, in Marshall Channel, off the northwestern point of Slipper Island, northeastward of Table Island, and southward of Jerry Islet.

CHAPTER VII.

PREPARIS CHANNELS AND GULF OF MARTABAN TO TAVOY RIVER.

Preparis South Channel, separating Table Island of the Coco Group from Preparis Island, is about 35 miles in width, and there are depths of 109 and 150 fathoms, coarse sand, near its central part. This channel is often used by vessels working down the Bay of Bengal against the southwest monsoon from Calcutta to pass eastward or to leeward of the Andaman Islands. Table Island, with its light, affords a good mark.

Preparis Island, situated nearly midway between Great Andaman Island and the coast of Pegu and 55 miles south-southwest of Alguada Lighthouse, is $4\frac{1}{2}$ miles in length in a north-northeast and south-southwest direction, about $\frac{3}{4}$ mile in breadth, and 265 feet in height, covered with wood, and slopes gradually.

A reef fringes the island and extends southward in a spit about $\frac{1}{2}$ mile wide for a distance of $3\frac{1}{2}$ miles from its southern point.

The eastern side of the island is steep, there being a depth of 10 fathoms about $\frac{3}{4}$ mile from the shore. The island was uninhabited in 1887, when many monkeys were seen there, and a few turtles.

Dangers.—A pinnacle rock, 40 feet high, lies $4\frac{1}{2}$ miles southwestward of the south point of Preparis Island, and a reef extends $2\frac{1}{2}$ miles southward from this rock, having, near its southern end, a small rock 6 feet high; this reef is surrounded by a bank with depths of from 4 to 10 fathoms, its southern end being 7 miles south-southwest of the south point of Preparis Island.

A reef $2\frac{1}{2}$ miles in length in a north and south direction, and $1\frac{1}{2}$ miles wide, with some islets, about 90 feet high, upon it, lies with its outer edge $2\frac{1}{2}$ miles westward of Preparis Island; in the narrow channel between this reef and the island the depths are from 9 to 15 fathoms.

A rock, awash at low water, lies about $\frac{1}{4}$ mile offshore and about $\frac{3}{4}$ mile south-southeastward of the northeastern point of Preparis Island.

Cow and Calf Islets, three in number, clifty, flat topped, and 77 feet high, lie close together about $1\frac{1}{2}$ miles north-northeastward of the northern end of Preparis Island; a bank with depths of from 6 to 10 fathoms over it extends nearly 2 miles southeastward from

them, and a pinnacle rock with about $1\frac{1}{2}$ fathoms water over it is reported to have been seen at the southeastern end of this bank, about 2 miles eastward of the north end of Preparis Island.

A narrow channel, in which are depths of 11 to 24 fathoms, separates these islets from Preparis Island.

Anchorage.—During the southwest monsoon there is anchorage on the eastern side of Preparis Island in depths of from 12 to 14 fathoms; and during the northeast monsoon anchorage can be found on the western side.

Water.—On the eastern side of Preparis Island, southeast of its highest part, and at a few paces from a sandy beach, formed between two ledges of rock, where boats can land with safety, there is a pond of fresh water, convenient for watering.

Preparis North Channel, between Preparis Island and Alguada Reefs, is about 52 miles in width, with general depths of from 15 to 50 fathoms.

Thalia Shoal, on which the least depth found is 10 fathoms, over coral bottom, is about $1\frac{1}{2}$ miles in length, in a north-northwest and south-southeast direction, and $\frac{3}{4}$ mile in width within the 20-fathom contour; it is situated 20 miles northward of Cow and Calf Islets. The depths around the shoal vary from 24 to 46 fathoms, the bottom generally being gray sand and coral.

Tide rips are charted about 19 miles westward of Alguada Lighthouse in a position where breakers were reported in 1907.

The 100-fathom contour appears to run almost north, with slight indentations, from Preparis Island to a position about 25 miles westward of Cape Negrais.

Alguada Reefs, on the northern side of Preparis North Channel and about 1.7 miles in length in a northeast and southwest direction, are nearly awash at high-water spring tides.

There are detached sunken rocks at a considerable distance from Alguada Reefs, the shoalest to the southward being a patch with $2\frac{1}{4}$ fathoms water over it about $1\frac{1}{4}$ miles southward of the lighthouse; among the several patches northward of the reefs, Hugh Rose Rock, awash at low water, and $2\frac{1}{2}$ miles north-northeastward of the lighthouse, is the northernmost and shoalest.

Light.—A granite tower, 160 feet in height, painted in black and white bands, 18 feet wide, with black base, is situated on the southwestern part of Alguada Reefs, from which is exhibited, at an elevation of 144 feet above high water, a flashing white light, visible 18 miles. (For details see Light List.)

Directions.—The lighthouse should not be approached on northerly bearings nearer than 3 miles, at which distance its angle of elevation from vane to base is 30° . Haing-gyi Island summit well open eastward of Diamond Island, bearing 20° , leads about $\frac{1}{4}$ mile

eastward of the shoal water off Alguada Reefs, and of Phaeton Shoals.

Tides.—It is high water, full and change, at Alguada Lighthouse at 9h. 13m.; springs rise $8\frac{1}{2}$ feet, neaps rise 6 feet.

Tidal streams.—In Preparis North Channel the tidal streams during the northeast monsoon are very irregular; at springs the flood stream sets south-southeastward and southeastward, and the ebb southwestward, at a rate of about 2 knots; during neaps there is usually a constant set southward, of from 1 knot to $1\frac{1}{2}$ knots an hour, but the ebb stream has been found setting northward at about half to three-quarters of a knot for 6 hours.

At Alguada Reefs the streams are much influenced by the winds, especially at neaps; the flood stream usually sets southeastward and the ebb northwestward. In the northeast monsoon at springs the ebb stream begins about two hours after high water and runs until low water at a rate of from 1 knot to 2 knots an hour, the period of slack water being very short.

Irrawaddy River, formed by the junction of the N'maikha and Malikha, two streams which rise in the hills in the north extreme of the Province, reaches the sea by nine principal mouths, viz, Bassein (and its eastern entrance the Thatkethaung), Ywe, Pyamalaw, Irrawaddy (Yahaudi), Kyondon (Da-la), Pyapon, China Bakir, or Thou khwa, and Rangoon. Some of these are of considerable breadth, but the Bassein and Rangoon mouths are the only ones at present used by seagoing ships. The Irrawaddy Mouth, in longitude $95^{\circ} 3'$ east, is said to be the straightest channel to the sea; it has a depth on the bar of 12 feet at low water springs, but is seldom used.

It is navigable through the greater part of its course for steamers at one season of the year, and the steamers of the Irrawaddy Flotilla Co. run through the greater part of its course, bringing exports from the up-country stations and returning with imports; some of these vessels are in themselves floating bazaars.

The river is the main source of water supply to the towns and villages on its banks, but it is tidal as far as Danubyu, about 70 miles from the coast; at two points, between Amarapura and Sagaing and between Tharrawaw and Henzada, it cuts through a line of railway and is crossed by a steam ferry, and is at present bridged in no part, but a railway bridge is contemplated at the former of the two ferries.

The Irrawaddy Delta is constantly encroaching on the sea, owing to the immense quantity of silt brought down by the river, and is cut up into many low islands by numerous tidal creeks and channels. Scattered along the southern parts of these are temporary villages, occupied during the dry season by salt boilers and makers of nga pi or fish paste.

Obelisk.—A small obelisk, 9 feet high, is situated on the reef near the southeastern extreme of the point.

Landing—Water.—Eastward of the obelisk there is shelter for boats and landing in the northeast monsoon; and good fresh water may be obtained from the well at the bottom of the steps leading to the pagoda.

Haing-gyi Island, $3\frac{1}{2}$ miles northeastward of Pagoda Point and on the western side of the river, is triangular in shape, about $3\frac{1}{2}$ miles in length in a northeast and southwest direction, and $2\frac{1}{2}$ miles in width at its southern side; a hill, 1,600 yards from northeast point of the island, is 445 feet high, densely wooded, sloping away to the southward, and conspicuous; the rest of the island is flat and covered with jungle about 35 feet high, but a large round tree, 72 feet high, on the southeast point of the island is useful as a mark.

Sand Cay, a rocky patch, part of which is 2 feet above high water, lies about $\frac{1}{2}$ mile southwestward of Rocky Point, the south extreme of the island, and shoal water, with depths of less than 3 fathoms, fills the bight between Sand Cay and Pagoda Point, and midway between them extends $1\frac{1}{4}$ miles southward of the line joining the cay and point. The channel westward of Haing-gyi is navigable only by boats at high water.

Village.—A village is situated at the northern end of the island, and the inhabitants are chiefly employed in fishing and manufacturing fish paste.

Water.—Good water can be obtained at the village.

Wolf Rock, 800 yards from the eastern side of Hain-gyi, dries at low water, and shoal water extends about the same distance eastward of the rock.

Buoy.—A can buoy, painted black, is moored on the edge of the 5-fathom contour, eastward of the rock.

Purian Point, on the eastern side of Bassein River entrance and about 7 miles east-southeastward of Diamond Island, is low like all the eastern shore of the river, but near its extremity a grove of trees, 75 feet high, shows above the ground northward. White sandstone cliffs about 10 feet high extend $1\frac{1}{2}$ miles northeastward of the point.

A patch of reef, which dries 6 feet, lies about 1,600 yards south-southwest of Purian Point, and rocks stretch off the southwestern sides of the point.

Martin Rocks, a small patch 4 feet high, dark and jagged in appearance, lie about 1,800 yards northwestward of Purian Point; and on the western side of the point, abreast these rocks, white sandstone cliffs, 30 to 45 feet high, extend for $1\frac{1}{4}$ miles, and are then lost in the jungle.

Purian Bank.—Ward Point lies about $10\frac{1}{2}$ miles northward of Purian Point, and Purian Bank, on which are depths of less than 3

fathoms, extends about $5\frac{1}{2}$ miles westward of the shore between them.

Orestes Shoal, lying between Pagoda Point and Diamond Island, has depths of 3 fathoms, and is about 1,200 yards in extent.

Buoy.—A conical buoy, painted red, is moored in about 6 fathoms water 2.2 miles southward of the southeastern point of Haing-gyi Island.

Burgess Rock.—Burgess Rock, with a depth of 3 fathoms over it, lies on the eastern side of mid-channel, about 1 mile southeastward of the Northeast Point, Haing-gyi Island; the shoal surrounding it is about 400 yards in extent inside the 5-fathom contour.

Buoy.—A nun buoy, painted red, is moored on the northern side of Burgess Rock. The buoy should be passed on its western side and given a berth of not less than 400 yards.

Directions.—It is usual in approaching Bassein River to pass westward of Diamond Island, giving it a berth of at least a mile to clear the reefs extending off it. Pilots come off from the pilot station on the eastern side of the island on the signal being made.

From the westward, if proceeding to the anchorage eastward of Diamond Island, steer to pass about 1 mile northward of the island, rounding the buoy which marks the extreme of the shoal extending from Baroni Rock, and when Alguada Lighthouse opens well westward of Diamond Island, bearing 206° , steer for the anchorage.

To enter the river from a position about $1\frac{1}{4}$ miles northward of the north point of Diamond Island bring Haing-gyi Island summit to bear north-northeast, or, if it is visible, in line with Sand Cay, southward of the island, and steer for it, which leads over the bar in about $3\frac{1}{2}$ fathoms at low water (the pilots report 1 foot less), and when Pagoda Point bears 300° alter course to pass westward of Burgess Rock, leaving red buoys on the starboard and black buoys on the port hand.

The river above Haing-gyi is strictly pilotage water, and directions can not be given.

River above Ward Point.—Dalhousie or Fytche Point, on the north bank of the river, $2\frac{1}{2}$ miles northward of Ward Point, is a bluff about 40 feet high with pagodas on it.

The northern part of Long Sand, eastward of Stony Point, which is nearly 3 miles northeastward of Dalhousie Point, is covered with trees about 25 feet high.

Dzen jung gli (North Travers Island) and Dzen jung ji (South Travers Island), on the eastern bank of the river about 4 miles above Long Sand, are about 55 and 50 feet high, respectively, and are connected by a mud bank which dries at low water. Dzen jung ji has a thin clump of trees on its summit, which is noticeable from the southward.

South Passage, northeastward of Dzen jung gli, is marked by black buoys, and other parts of the river above are buoyed.

In Bassein River, starboard hand buoys, entering from seaward, are painted red; port hand buoys black.

Tides.—It is high water, full and change, at the entrance of Bassein River at 9h. 47m.; springs rise $7\frac{1}{2}$ feet, neaps $5\frac{1}{2}$ feet.

Tidal streams.—One mile northward of Diamond Island the tidal streams at springs are rotary; the flood at its commencement setting about south-southeast $\frac{1}{2}$ east turning through east, and ending at about northeast by east, the ebb at its commencement setting about northwest, turning through west, and ending at about southwest; the rate of both streams is greatest in the second and third quarters of the tide, when it is $1\frac{1}{2}$ knots an hour.

Near the bar the flood stream sets about east, and the ebb about southwest by south, at rates of from 1 knot to 2 knots at springs.

Bassein Town, 75 miles within Bassein River entrance and situated in the middle of a fertile rice-growing district, is resorted to by vessels principally between January and September (March being the busiest month), for the shipment of that grain for Europe. The town stands on a slight eminence on the east bank of the river, and Shwe mu htaw Pagoda rises from the center of a fort, within which are the court houses and treasury.

On the opposite side of the river is the small Theng bhaw gyeng suburb containing rice mills and store yards of the principal merchants, and a port officer resides here. Vessels of 27 feet draft can load nearly alongside the mill jetties, temporary gangways being constructed between. The population in 1901 was 31,864.

Communication.—There is regular communication three times a week with Rangoon by the steamers of the Irrawaddy Flotilla Co., the passage taking about 26 hours, and communication by railway with Rangoon and Prome. There is also telegraphic communication and a radio station at Diamond Island.

Radio station.—A radio station is established at Bassein Town which only communicates with vessels when in distress.

Storm and weather signals are shown at Bassein.

The call letters are V.T.B.

Coal and supplies.—A small supply only is kept by the Irrawaddy Flotilla Co. for its own steamers; about 10,000 tons are imported annually. A coal boat holds 53 tons, and 450 tons could be put on board in 24 hours; a jetty about 50 feet in length has a depth of 30 feet at its extremity.

Supplies of fresh provisions can be obtained, also water from the mill wells.

Hospital.—There is a hospital for Europeans and a native hospital.

Trade.—The exports consist chiefly of rice, with small quantities of timber, horns, and hides; and the imports, coal from Australia and Bengal, gunny bags, salt, coconuts, and piece goods.

Climate.—The climate of Bassein is relaxing owing to the situation of the town in the delta of the Irrawaddy and to the muddy banks of the river and creeks, which are covered during the greater part of the day. The total rainfall is sometimes over 100 inches, the greater part falling between June and September.

Health.—Cholera prevails mostly from February to May; pure water and a strictly wholesome diet are the only safeguards against it. All drinking water should be boiled. Smallpox is never widely epidemic, as the vaccination act is in force. Vessels having no case of infectious disease for 10 days from date of departure from an infected port are allowed pratique; vessels in quarantine are allowed to load under certain conditions.

Myaungmya and Pyapon Districts.—The coast line of Myaungmya District extends from the eastern side of the entrance to Bassein River to the western side of the entrance to the Irrawaddy, a distance of nearly 40 miles, and that of Pyapon from the latter to China Bakir River.

Coast.—The north shore of the Gulf of Martaban trends eastward from the mouth of the Bassein River about 70 miles, or to the vicinity of Krishna Shoal, and then northeastward for about 110 miles to the head of the gulf into which flows the dangerous bell-mouthed Sittang River. The coasts of Irrawaddy and Pegu Divisions, in which is comprised the delta of the Irrawaddy, are low and wooded, and nothing noticeable is to be seen from outside the extensive shallow banks which front them.

Banks.—From Bassein River entrance the 5-fathom contour on the edge of the banks off the coast trends east-southeastward for about 52 miles, then northward of east for about 27 miles, and northeastward to the head of the Gulf of Martaban. These banks should not be approached to less than 10 fathoms while westward of Krishna Shoal.

Baragua Flats, opposite the main entrance of Irrawaddy River, extend many miles from the land, which is not visible from their southernmost part.

Lightvessel.—A lightvessel, painted red, with "Baragua" on the sides, and having one mast, with two red balls at the masthead, is moored in a depth of about 8 fathoms, southward of Baragua Flats, and exhibits, at an elevation of 45 feet above the level of the sea, an alternating flashing light, visible 12 miles. (For details see Light List.)

Fogsignal.—Two guns in succession. (See Light List.)

Buoy.—A watch buoy, painted black, is moored about $\frac{3}{4}$ mile northeastward of the lightvessel.

Mariners are warned to keep well to the southward of the lightvessel.

Krishna Shoal is a narrow ridge which, within the 3-fathom contour, is 13 miles in length in a northeast and southwest direction, and about 3 miles across at its widest part, with depths of from $1\frac{1}{4}$ to $2\frac{3}{4}$ fathoms, over hard sand; it is separated from the eastern side of Baragua Flats by a channel $3\frac{1}{4}$ miles broad, in which the depths are from $3\frac{1}{4}$ to 4 fathoms.

Lightvessel.—A lightvessel, painted red, and with one mast, a red ball at the masthead, and “Krishna” on the sides, is moored in a depth of $4\frac{1}{2}$ fathoms about 6 miles eastward of the southwestern extreme of the shoal, or 27 miles east-northeastward of Baragua Lightvessel.

It exhibits, at an elevation of 43 feet above the level of the sea, a group flashing white light, visible 12 miles. A blue light is burnt every half hour, between 7 p. m. and 5 a. m. (For details see Light List.)

Fogsignal.—A gun is fired. (See Light List.)

Beacons.—Upey and Pymbong Beacons are situated on the southeastern end of Pyapon Island, about 14 miles west-northwestward and 12 miles northwestward, respectively, from Krishna Lightvessel.

China Bakir Light.—A lighthouse, built on iron screw piles, painted red, with a white lantern, stands in 4 feet at low water, on the edge of the flat extending off the entrance of China Bakir River, from which is exhibited, at an elevation of 74 feet above high water, a fixed and flashing white light, visible 14 miles. (For details see Light List.)

Directions—Rangoon River Approach.—From the westward pass 5 miles southward of Alguada Reefs Lighthouse and steer about 103° to pass about 5 miles southward of Baragua Flats Lightvessel, from which steer about 80° for 15 miles, and then alter course to about 51° for a position 5 miles eastward of Krishna Lightvessel. Thence steer about 46° to make China Bakir Lighthouse, not shoaling the water to less than $4\frac{1}{2}$ to 5 fathoms at low water.

A vessel working up the gulf and making China Bakir Light bearing eastward of 23° should at once haul to the southeastward and not approach the light nearer than 4 miles, until it bears westward 1° .

During February and March, when thick fogs prevail, great caution is necessary in approaching Rangoon River entrance, as there is not a sufficiently marked change in the soundings in the channel to enable the position to be determined by the lead; no attempt should be made to enter the river without first sighting China Bakir Lighthouse or Light.

From the eastward a vessel should be kept in depths of from $5\frac{1}{2}$ to 6 fathoms at low water until about 10 miles from China Bakir Lighthouse, and in thick weather China Bakir Lighthouse or Light should be sighted before proceeding.

China Bakir Lighthouse or Light should be made between the bearings of 282° and 12° .

Caution.—Off the coast between Bassein River entrance and Krishna Shoal, especially at night and during spring tides, the lead should be frequently used and the vessel kept in a depth of not less than 10 fathoms at low water, and in shaping course allowance should be made for the set of the tidal streams and for an indraft, during the rising tide, into the mouths of the Irrawaddy. The ground log should be used.

It should also be borne in mind that it is high water at Alguada Reef about six hours earlier than at China Bakir Lighthouse when calculating the time and turn of the stream in any position between those places.

The land at the river entrance, being very low, is not visible from seaward until about 7 miles from the shore and in depths of $4\frac{1}{2}$ to $4\frac{3}{4}$ fathoms at low water. It is necessary to guard against being set to the eastward of Rangoon River, as the flood stream runs very strongly over the sands at the entrance of Sittang River.

Outer anchorage.—If of moderate draft, after making China Bakir Lighthouse or Light steer northeastward until it bears 260° , distant about $6\frac{1}{2}$ miles, then anchor in about $3\frac{1}{2}$ fathoms at low water; but if over 18 feet draft, anchor in $4\frac{1}{2}$ fathoms at low water, with China Bakir Lighthouse bearing 316° , distant 5 miles.

Tides.—It is high water, full and change, at China Bakir Lighthouse at 3h. 3m.; springs rise 16 feet, neaps rise 11 feet.

Westward of the entrance to Irrawaddy River the current in the fine season is irregular, and varies with the direction of the wind, having no apparent connection with the rise or fall of tide.

Off Irrawaddy River and Baragua Flats the tidal streams are rotary, shifting in the direction of the hands of a clock, and attaining, during the fine season, about equal velocities of from $1\frac{1}{2}$ to 2 knots at springs and about $\frac{3}{4}$ knot at neaps.

Near the shore the tidal streams set in and out of Irrawaddy River, attaining their greatest velocity at high and low water.

Between Baragua Lightvessel and Rangoon River entrance the streams set to the northeastward and southwestward, attaining at springs, during the northeast monsoon, a velocity of from 2 to 4 knots, which increases off the entrance to the river.

The southwesterly stream is the stronger.

Occasionally in October and November a steady westerly set is experienced, quite overcoming the flood stream. During November,

December, and January there is little or no flood stream southward of Alguada Reefs, except at spring tides.

Winds.—At Rangoon River entrance in December the wind is northeasterly, veering eastward and blowing fresh during the day: the weather is generally fine. In January the wind is more northward, and sometimes there is a strong easterly wind for several days; toward the end of the month light land and sea breezes commence; the weather is thick and hazy.

In February land and sea breezes are regular, the latter being fresh near the shore; thick fogs prevail. In March light land and sea breezes continue, and the weather is foggy. The sea breeze is generally strongest at the time of spring tides.

The southwest monsoon commences about the middle of April, and after a few stormy days the weather is clear until the beginning of May, when the monsoon has fairly set in, and continues with breaks of a few days of fine weather until the end of October.

Hanthawaddy District.—The coast line of Hanthawaddy District extends in a northeasterly direction for a distance of about 40 miles between China Bakir and Sittang Rivers, Rangoon being the port.

Rangoon River, a branch of the Irrawaddy, known in the north as the Myitmaka, rises in the mountainous district of Prome in Upper Burma, in latitude $18^{\circ} 50'$ north, longitude $95^{\circ} 25'$ east, and for a distance of 150 miles flows south-southeastward and nearly parallel to the Irrawaddy River. About 50 miles from its mouth it takes a more easterly direction, and under the name of Hlaing River is joined by several large creeks, the chief of which are Panhlaing Creek, Pegu River, and Bassein Creek; this portion of the river is navigable by steamers of light draft.

Below the Panhlaing or Pan-y-can Creek it is known as Rangoon River, and separates the city and cantonments of Rangoon from the dockyard suburb of Dala, which is on the south bank close to the entrance to Twante Canal; it flows from this in a southeasterly direction, entering the Gulf of Martaban between Elephant Point and Eastern Grove Lighthouse.

Ocean steamers can ascend the river to Rangoon, but no higher, and skilled navigation is required for the 21 miles between Rangoon and the sea.

The land at the entrance is low, and for the most part covered with jungle, forming mangrove and tidal forests, and there is but little cultivation. Owing to the great rise and fall of tide, and the rapidity of the tidal stream, the water is charged with a large quantity of deposit, and the river is a deep yellow color.

Western side of entrance.—Lekogon Pagodas, situated on the coast about 4 miles northwestward of China Bakir Lighthouse, con-

sists of a group of small pagodas, standing close together, and being of a brown color and about the same height as the surrounding groves of trees, are not easily recognized.

From Lekogon Pagodas the coast trends in a northeast direction for about 13 miles to Elephant Point, and is, first, belts of thick forest jungle and grass, and afterwards mangrove trees, with some cultivated land between. A clump of trees, charted about $3\frac{1}{2}$ miles southwestward of Elephant Point, is not easily recognized.

China Bakir Flats, on the western side of which is the entrance to China Bakir River, dry at low water to an average distance of 2 miles from the land, extend $4\frac{1}{2}$ miles southward of the coast at Lekogon Pagodas, their southern part being about $2\frac{1}{4}$ miles wide, and similar flats border the coast to Elephant Point, at distances of from $1\frac{1}{4}$ to 2 miles off, the edge from Elephant Point having a southeast direction for a distance of 2 miles; this latter portion of the flat is named Spit Sand.

Some beacons, used in the survey, stand on the flat, and tide gauges are situated on its edge, about $6\frac{1}{4}$ miles south-southwestward and 600 yards east-southeastward of Elephant Point.

Elephant Point is very low, with some houses, a flagstaff, and a few tall palm trees near it.

Lights.—Two fixed white lights are shown from posts on Elephant Point, at elevations of 15 and 33 feet, respectively, above high water; their positions in line are altered to meet changes in the channel. The lights are visible about 5 miles.

Signal station.—The signal station, situated 700 yards south-southwestward of the light posts on Elephant Point is the property of the Indian telegraph department, and can signal messages or orders by means of the flags of the International Code.

Storm and weather signals are shown from the signal station flagstaff.

Eastern side of the entrance.—Grove Point, situated about $2\frac{1}{4}$ miles northeastward of Elephant Point, is also low.

Light, 1,600 yards eastward of Grove Point, the eastern entrance point of Rangoon River, and 100 yards below high-water mark, is Eastern Grove Lighthouse, built on iron screw piles, 105 feet in height, and painted red, with a white lantern, from which is exhibited, at an elevation of 93 feet above high water, an occulting white light, visible 15 miles. (For details see Light List.)

Eastern Grove Flats.—The southwest edge of these extensive flats of mud and sand, which dry at three-quarters ebb, stretches in a southeast direction for a distance of 6 miles from Grove Point, outside which the edge of a shoal, not defined, trends to the eastward at a distance of about 8 miles from the shore.

Eastern Sands, which lie on the eastern side of the entrance and nearly 4 miles south-southeastward of Grove Point, are about 2 miles in length in a north-northwest and opposite direction, and 1 mile in width; portions of the sands dry at low water, spring tides, the highest part being 4 feet above water. The shoal on which they stand extends about 3 miles southwest, and this part is named **South-west Tail**; shoal water also extends about 1 mile southward and 2 miles eastward of the south point of Eastern Sands.

The shoal water to the northward curves to the northwestward, and at $1\frac{1}{2}$ miles is another large patch which dries 4 feet; from this the shoal water occupies nearly the middle of the river for 2 miles northwestward to the eastern end of Middle Bank (*Alle Thoung*), which is about 3 miles in length in a west-northwest direction, and dries 8 feet.

There is a heavy sea on these outer dangers during bad weather.

Range lights.—Two small fixed white leading lights are exhibited from masts on the south bank of the river, about $\frac{1}{2}$ mile west-northwestward of Pila Kuh Chaung (*Deserters Creek*), at elevations of 20 and 40 feet, respectively, above high water; they are 106 yards apart, and when in line, bearing 290° , lead between Elephant Point and Middle Bank.

From a post, erected at 600 feet, 334° , from the rear light of these leading lights, a fixed white light is exhibited at an elevation of 30 feet.

This light, in line with the rear light, bearing 154° , leads through the channel between Motjua and Hmawwun Lumps.

Entrance.—The entrance to the river, between the edge of the flat off the western side and the south extreme of Eastern Grove Flats, is about 6 miles in width, but Eastern Sands, which dry, with the shoals surrounding it, occupy the greater part of the center and eastern side of the entrance, dividing it and forming Western and Eastern Channels.

The Western Channel lies along the edge of the 3-fathom contour of the narrow fringe of shoal water off the flat on that side, and the narrowest part between it and the similar contour of the shoal extending about $7\frac{1}{2}$ miles southwestward of Eastern Sands is 700 yards in width, at nearly mid distance between China Bakir Light-house and Elephant Point; within this the channel widens.

The Eastern Channel between the 3-fathom contour on the east side of Eastern Sands and the western edge of Eastern Grove Flats is about 800 yards at its narrowest part, 1 mile northeastward of Eastern Sands; but this channel is not buoyed, nor is it used for navigation.

Caution.—Changes in the depths and in the position of the banks in Rangoon River and its entrance are so frequent that the plan and

directions can never be absolutely relied on. The lights, buoys, and lightvessels are moved as necessary to mark the channels.

Depths.—A shoal with a depth of 18 feet over it lies in mid-channel of the narrowest part at the entrance to Western Channel; otherwise the depths are 19 feet, but shoaling is reported in this locality; the depths increase farther in, with from 40 to 75 feet off Elephant Point.

There is a depth of 21 feet at the entrance to the Eastern Channel.

Monkey Point Channel, between Hastings Sand and Shoal on the south and Monkey Point on the north, was originally dredged to a depth of 15 feet on the line of the range marks. In May, 1913, the depth in the channel, on the range line, was $8\frac{1}{2}$ feet. In 1906 the British naval vessel *Terrible*, drawing 30 feet 1 inch, entered the port of Rangoon.

Spit Lightvessel.—A lightvessel, painted red, with "Spit" on the sides, is moored, in 24 feet water, on the eastern side of the Western Channel, $2\frac{1}{4}$ miles southeastward of Elephant Point, and exhibits, at an elevation of 45 feet above the level of the sea, a fixed white light, visible 12 miles. The vessel is shifted to meet the changes in the channel.

Buoy.—A red conical watch buoy is moored about 200 yards north-northeastward from the lightvessel.

Buoyage.—Between the sea and Rangoon the channel is marked by red buoys on the starboard hand and black buoys on the port hand, entering from seaward.

Lightbuoys and buoys.—The fairway buoy at the entrance to the western channel, painted black and white in horizontal bands, exhibits an occulting white light, and is moored in 21 feet water, 5 miles eastward of China Bakir Lighthouse. (For details see Light List.)

The western channel is marked on its western side by seven buoys, painted black, as follows:

Lower Western Buoy, can, in about 20 feet.

Center Western, conical, in about 19 feet.

Upper Western, conical, in about 21 feet.

Lower Spit, can, in about 24 feet.

Center Spit, exhibiting a fixed white light, is moored in about 35 feet 2.4 miles southeastward of Elephant Point.

Intermediate Spit, can, in about 20 feet.

Upper Spit, conical, in about 24 feet.

The eastern side of Western Channel is marked by four buoys, painted red, as follows:

Lower Eastern Buoy, conical, and surmounted by a diamond, in about 17 feet, $4\frac{1}{2}$ miles eastward of Lower Western Buoy.

Center Eastern, conical topped, in about 15 feet, nearly 2 miles eastward of Upper Western Buoy.

Upper Eastern, conical topped, and surmounted by a triangle, in about 30 feet, 1.2 miles eastward of Lower Spit Buoy.

Upper Ridge, conical, in about 25 feet, 1.2 miles eastward of Elephant Point.

The southwest edge of Middle Bank is marked by four buoys, painted red, as follows:

Lower Middle Bank, conical, nearly $\frac{1}{2}$ mile north-northwestward of Elephant Point.

Center Middle Bank, conical, and surmounted by a diamond.

Intermediate Middle Bank, conical, and surmounted by a St. Georges cross, marks an extension of Middle Bank.

Upper Middle Bank, conical.

Pilots.—The pilot brig, painted white and carrying a red and white horizontally-striped flag, is usually at the pilot's cruising station, about 4 miles southeast by east of China Bakir Lighthouse. At night the pilot brig shows the following lights:

(1) When at anchor at the station on pilotage duty, a fixed white light at the starboard fore-topsail yardarm, at an elevation of 43 feet above the level of the sea, and a similar light at the stern, 15 feet below the preceding one; a flare-up light or lights will also be shown at short intervals of not more than 15 minutes.

(2) When under way and at the station on pilotage duty, a white light at the main-topgallant masthead, visible in all directions, and also a flare-up light or lights as in (1).

By day a black ball is hoisted at the fore yardarm. When this signal is shown vessels should approach the brig with caution and not pass too closely under her stern.

(3) When not engaged at the station on pilotage duty, the usual navigating lights are shown.

Vessels over 100 tons are obliged to take a pilot. The pilots do not come out to the outer anchorage, but vessels there must get under way when there is water enough, and pick up the pilot at the pilot brig.

Tides.—It is high water, full and change, at Elephant Point at 3h. 32m.; springs rise 19 feet, neaps 13 feet.

The rise and fall of tide given above is for the dry season or from December to March; during the rains at springs, the rise at Elephant Point sometimes amounts to 21 and 22 feet.

The tides of Rangoon River are subject to a large diurnal inequality, which may either accelerate or retard the times of high and low water, sometimes as much as more than an hour.

From September to March the night tides are higher than the day tides in December and January, at springs, the difference is about 2 feet.

From March to September the day tides are higher than the night tides; the difference is greatest in June and July at springs.

Tidal streams.—At springs in the more confined parts of the channel into Rangoon River and along both shores of the Gulf of Martaban the tidal streams are rapid, running from 5 to 7 knots.

After the rains, the tidal streams outside Rangoon River have a rotatory motion; the first of the flood sets eastward, at half flood it sets northeastward, and toward the end of the flood northward; the ebb at its commencement sets westward, and it changes gradually through south to southeastward.

There is no slack water, the streams continuing at a rate of $1\frac{1}{2}$ to 2 knots.

In the Western Channel the flood sets northeastward along the shore as far as Upper Western Buoy, when it turns gradually northward into the river; its rate is from 5 to 6 knots at springs. The great body of the flood passes eastward into Sittang River; and in the Eastern Channel the flood is comparatively weak, setting northwestward, and makes from 20 minutes to 30 minutes later than in the Western Channel.

Inside Elephant Point, on the western side where the channel is confined by Middle Bank, the flood runs about 6 knots at springs, its rate decreasing as the northern part of Middle Bank is passed.

The ebb stream sets southwestward in the Western Channel outside Elephant Point; and southeastward in the Eastern Channel, with a rate of 6 knots at springs, gradually altering its direction southwestward, as it sweeps around the southeastern edge of Eastern Sands. Inside the river the stream generally takes the course of the channel, and there are strong eddies off the various points during spring tides.

The tidal stream is strongest on the night of the second day after full or new moon; it then runs in the channels at the rate of 7 knots an hour, with only a few minutes slack water. After neaps the streams gradually increase in strength, and are rapid until the moon quarters, when they suddenly slacken; on the second and third day after the moon's quartering there is slack water on the flood for one and one-half hours, and on the ebb for one hour.

The flood tide at springs makes suddenly and rises 6 feet in the first hour; the ebb stream, however, still continues running in mid-channel, and it is not slack water until one hour after the water has commenced to rise. The flood stream turns earlier inshore than in mid-channel.

During the rains, or from June to September, inclusive, the flood stream is weaker and the ebb stronger than during the remainder of the year, and at times vessels do not swing to the flood off the city of Rangoon.

Caution.—At half flood, when the banks are covered, the stream after passing Upper Western Buoy, runs over Spit Sand directly toward Elephant Point. The ebb stream sets from Center Spit Buoy across the channel on to a part of Eastern Sands.

River above Elephant Point.—Hmawwun Lumps, off the mouth of Hmawwun Chaung, a creek on the east bank about 7 miles northwestward of Grove Point, has 11 feet water over it at low water, and is about $\frac{3}{4}$ mile westward of the western edge of a sand flat, which dries 8 feet and lies off the mouth of Hmawwun Creek.

Buoy.—The southwestern side of Hmawwun Lumps is marked by a conical buoy, painted red, and moored in a depth of about 20 feet about 300 yards from the shoal.

Bassein Creek, which flows southwestward into China Bakir River, has its entrance on the western bank of Rangoon River, 10 miles northwestward of Elephant Point.

Beacons.—Between Elephant Point and Bassein Creek are the following beacons, with their respective distances from Elephant Point: Tree Beacon, 1.4 miles; Motjua Beacon, a tripod surmounted by a ball, and painted white, 3.6 miles; and Hmawwun Beacon, a mast surmounted by a ball, painted black, 7.2 miles.

On the east bank of the river, opposite Bassein Creek, is South Beacon, painted white, surmounted by a basket.

Da Silva Shoal, the southern extreme of which, with a depth of 7 feet, is 1.6 miles northeastward of Bassein Creek, has a least depth of 4 feet over it, about 700 yards northward of its south extreme; the eastern edge of this shoal has extended in an easterly direction and is steep-to on its east side, there being only a depth of 8 feet close westward of the line of Syriam Great Pagoda in one with the Umbrella Tree.

Choki Lumps Shoal, about $\frac{3}{4}$ mile in length in a north-northwest and opposite direction and 200 yards in width, has a least depth of 11 feet over its central part; its southeast extreme is 600 yards northward of Da Silva North Point, and its north extreme is about the same distance southward of Choki Point on the east bank of the river, with detached patches between.

Buoys.—The southwestern side of Choki Lumps Shoal is marked by two conical buoys, painted red.

A conical buoy, painted black, is moored on the eastern side of an 18-foot patch 800 yards westward of the northern of the above buoys.

Devils Hole Range Lights.—About 700 yards north-northwestward of Devils Hole Creek, which is situated on the east bank, about 1 mile northward of the south extreme of Da Silva Shoal, three fixed white range lights are exhibited from masts, one, as a rear light, being for use with either of the others as front lights, for ranges up or down the river.

Choki Point Range Lights.—At Choki Point, on the east bank, two fixed white lights are exhibited from masts; they are 200 yards apart.

Western Channel Range Lights.—Two fixed white range lights are exhibited from masts, situated about 1,300 yards westward of Da Silva North Point; they are 133 yards apart.

All the above are lantern lights.

The southern of Devils Hole Front Lights in line with the rear light, bearing 15° , leads eastward of Da Silva Shoal.

Choki Point Leading Lights in line, bearing 328° , lead northeastward of the northern part of Da Silva Shoal, in about mid-channel.

The northern of Devils Hole Front Lights in line with the rear light, bearing 117° , leads northward of Da Silva North Point, and between it and Choki Lumps Shoal.

Western Channel Range Lights in line, bearing 174° , lead westward of Choki Lumps Shoal, in mid-channel, and between Liffey Island and Shoal and the east bank of the river.

Beacons.—Between Da Silva North Point and Kings Point are the following beacons: A beacon consisting of a mast surmounted by a ball, painted black, 1,400 yards westward of Da Silva North Point.

West Harbor Beacon and Old West Harbor Beacon, distant 1 mile and 200 yards, respectively, south-southeast of Kings Point.

On the eastern bank two beacons are situated northward of Devils Hole Creek, the northwestern surmounted by two black balls, and the southeastern a mast, painted red, and surmounted by one ball.

North Beacon, with a square board, about 200 yards northward of the northwestern of the preceding beacons.

A beacon consisting of a mast surmounted by a ball at Choki Village.

Tree Beacon, surmounted by a ball, about 600 yards southeastward of Choki Point.

Two beacons, painted red, and East Harbor Beacon, on the eastern bank, abreast the middle of Liffey Island.

Two beacons, painted red, and Old East Harbor Beacon, on the eastern bank, abreast the south end of Hastings Sand.

There are also several survey beacons which will be seen on referring to the chart.

Liffey Island.—The western bank of the river has a general north-northwest direction from Da Silva North Point for 6 miles to Kings Point, and about 1.3 miles southeastward of the latter point is the north end of Liffey Island, covered with grass, which is rather more than 1 mile in length in a north-northwest and opposite direction; a strip of shoal water extends down the center of the river from the south point of the island for a distance of nearly 3 miles.

Beacon and buoy.—A mast beacon is situated on middle of the western side, and a conical buoy, painted black, is moored off the middle of the eastern side of Liffey Island.

Kings Bank Channel.—This dredged channel, between Liffey Island with the shoals extending southward from it and the mainland to the westward, is about 2 miles long, with a breadth varying from 600 to 1,000 feet, and a depth in May, 1913, of $9\frac{3}{4}$ feet at low water springs on the upper bar and 4 feet on the lower bar.

Buoys.—Kings Bank Channel is marked by five red conical buoys on the starboard hand, and four black can buoys on the port hand.

The southern red buoy is surmounted by a staff and globe.

Mark.—The northeastern corner of Shwedagon Pagoda, bearing 326° leads through the center of the channel.

Kings Bank Channel should not be navigated at night.

Hastings Sand lies between the north end of the sand extending northward of Liffey Island and Monkey Point; it is in the form of an inverted L, its side in a north and south direction being 1,700 yards, and its side east and west, 1,300 yards in length, the general breadth being about $\frac{1}{4}$ mile; it dries 6 feet in places, and on its western side is a detached patch which dries 1 foot.

Beacon and buoy.—A beacon stands near the south point of Hastings Sand.

Lower Hastings buoy, conical and painted black, marks the edge of the shoal water on the eastern side of Hastings Sand.

Hastings Shoal, with 6 feet water over it, is about $\frac{1}{4}$ mile in length, in an east and west direction, and 100 yards in width; it lies about 400 yards northward of the western end of Hastings Sand, on a shallow flat, with depths of from 8 to 17 feet over it, frequently changing, which is $1\frac{1}{2}$ miles in length in an east and west direction, and almost completely fills the entrance to the port, between Hastings Sand and Monkey Point and the river bank westward of it.

Lightbuoy.—The southern part of the eastern edge of the flat is marked by a conical buoy, painted black, exhibiting an occulting white light; it is situated about 200 yards northeastward of the northeast elbow of Hastings Sand.

(For details, see Light List.)

Monkey Point Buoy, conical, painted black, and surmounted by a staff and ball, is on the eastern edge of the flat, and marks the south side of Monkey Point dredged channel.

Pazundaung Buoy, conical, painted red, and surmounted by a staff and triangle, is also on the eastern edge of the flat, and is moored on the northern side of Monkey Point Channel.

Wreck—Lightbuoy.—A wreck buoy, painted green and exhibiting a fixed green light, is moored on the northern side of a wreck

which lies about 300 yards northeastward of the eastern end of Hastings Shoal.

Anchorage.—An anchorage for cargo boats, marked by eight red and white cask buoys, is established off the northwestern edge of Hastings Shoal.

Channels.—There are three channels across the shallow flat between Hastings Sand and Monkey Point; the southernmost of these is entered northward of the lightbuoy northeastward of Hastings Sand, and between it and Monkey Point Buoy, passing northward of Hastings Shoal.

Monkey Point Channel, the middle of the three, is dredged to a depth of 14 feet, and has 15 feet on the line of the range marks; in May, 1913, there was a depth of $8\frac{3}{4}$ feet in the central line of the dredged channel. It passes northward of Monkey Point Buoy, and between it and Pazundaung Buoy.

Lights.—Two fixed white leading lights, 240 yards apart, are exhibited at elevations of 40 and 60 feet above the river, respectively, from masts, situated 350 yards southward of Syriam Point Oil Pier, and when in line, bearing about 109° lead over Hastings Wreck.

Beacons.—There are three sets of beacons on Syriam Point; the southernmost pair are surmounted by single white diamonds, the middle pair by single white disks, and the northernmost by two white diamonds. These spar beacons are in line bearing 106° , 104° , and 103° .

Syriam Flat, and the shoal water extending from it, is situated northwestward and northward of Syriam Point, from which the south point of the shoal is distant 300 yards in a west-northwest direction; the edge of the shoal then curves around to the northeastward, and, with Syriam Flat, is distant 600 yards from the southeast bank of Pegu River.

Buoy.—The western edge of the shoal is marked by a conical buoy, painted red, situated about 1,200 yards northwestward of Syriam Point.

Examination anchorage.—The examination anchorage, in which the depths are from 47 to 82 feet, is in a space southeastward of Da Silva North Point, northward of a line drawn 270° from Devils Hole rear light mast, the northern limit of the anchorage being a line drawn 8° from Da Silva North Point, across the river.

Port of Rangoon.—The port extends from about $1\frac{1}{2}$ miles westward of Monkey Point, in that direction for fully 2 miles, with widths of from 500 to 800 yards, and depths of from 21 to 36 feet in the eastern, and from 36 to 82 feet in the western part, northward of Mill Point.

Mooring buoys.—There are 11 mooring buoys off the town, and vessels secure with their own cables to the pendants. The position of the buoys will be seen on the chart.

Alun Sand, which dries, and the shoal surrounding it, occupies about $1\frac{1}{4}$ miles of the north bank of the river from and westward of, opposite Mill Point; it extends about 1,400 yards from the north bank.

Buoys.—The south extreme of the shoal extending from Alun Flat is marked by a conical buoy, painted red, moored in 10 feet of water.

Bangoon River—General remarks.—Pilots report very little flood tide during approach to China Bakir Lighthouse during the rainy season. This helps deep-draft vessels which have to go over the flats on a rising tide.

Elephant Point is rapidly being washed away.

All leading marks up the river are extremely poor by day, consisting only of thin poles. Off Suddine H'moh Fishing Village, on the left bank, 200 yards inside the point of the creek, is a large tree standing by itself and making an excellent running mark on a 315° course which the pilots use.

Directions.—From the fairway buoy a 355° course will lead to the entrance to the Western Channel, about 1 mile eastward of Lower Western Buoy, when the course is about 23° for the Center Western Buoy, observing that this is the narrowest part of the channel, that the depths are uncertain, and a shoal, with a depth of 13 feet over it, is reported to exist about 600 yards southeastward of the Center Western Buoy, and that the water is said to be shoaling in this locality.

After passing Center Western Buoy, the Spit Lightvessel, if seen, may be steered for, bearing 35° , which should pass about $\frac{1}{4}$ mile eastward of Lower Spit Buoy, and to about the same distance southeastward of Center Spit Lightbuoy, from which the course is to the northward and northwestward, passing eastward of Intermediate and Upper Spit Buoys.

Elephant Point may be passed 200 yards distant, avoiding the northern elbow of the shoal of Spit Sand, and if the light posts can be distinguished, in line, they lead along the south edge of Middle Bank until abreast of Pila Kuh Chaung, when the pecked line on the plan should be followed, the courses being about 313° to Motjua, then 330° to about $\frac{1}{2}$ mile southeastward of Deepwater Point, and 338° to mid-channel between Hmawwun Beacon and Hmawwun Lumps.

Syriam Great Pagoda, open westward of North Beacon (square board), bearing about 9° , leads up the channel until nearing South Beacon, when the vessel should be kept more to the eastward to

bring Syriam Great Pagoda in line with the beacon surmounted by two balls, and close southeastward of North Beacon, bearing about 6° , which leads between Da Silva Shoal and the eastern side of the river, remembering that the bank on which Da Silva Shoal stands is steep-to and extending eastward, with only 8 feet close westward of the clearing mark.

Continue this course till nearly abreast Devils Hole Creek, when Shwedagon Pagoda, gilded from base to summit and situated northward of Rangoon should be brought in line with Choki Point, bearing 325° , and steering on this mark leads from 400 to 600 yards from the eastern bank, to abreast Choki Village, when alter course to about 279° to pass about 300 yards northward of Da Silva North Point, with Keikmalong Clump, situated $2\frac{1}{4}$ miles eastward of North Beacon, in line with the beacon mast surmounted by a ball at Choki Village, bearing 104° astern, which leads southward of Choki Lumps.

Having passed southward of Choki Lumps Red Buoy, the two beacons (front square board, rear mast and black ball), $\frac{3}{4}$ mile westward of Da Silva North Point in line, bearing 173° , used as a stern mark, should lead eastward of the 16-foot patch, marked by a black buoy, and up the channel, but these marks lead close to the eastern edge of Liffey Island Shoal; the eastern bank of the river is, however, clear of danger beyond the distance of 200 yards, and the vessel may be kept more toward that side when approaching Liffey Island.

Choki Point, bearing 161° with the western bank southeastward of Da Silva North Point, just shut in, leads just eastward of Liffey Island Shoal and Hastings Sand.

While approaching Syriam Point ascertain the rise of tide by the tidal semaphore at Kings Point before proceeding through Monkey Point Channel.

From southwestward of Syriam Point steer northwestward, leaving Lower Hastings Buoy on the port hand, and having passed eastward of the light buoy, northeast of Hastings Sand, proceed into the port through the most convenient of the channels over the flat, already mentioned, with the pair of beacons marking its fairway in line, but if passing through Monkey Point Dredged Channel, observing that dredgers may be at work in it.

Monkey Point Channel—Signals.—Vessels intending to enter the port through Monkey Point Channel during the daytime are required to hoist a black ball or shape, about 2 feet in diameter, half mast on the port side of the mainmast, when passing Choki Point, lowering the same for the information of outward-bound vessels, should any change take place regarding such intention.

Tide gauges.—In addition to the tide gauge at Elephant Point, others are situated at Choki Point, surmounted by a pole and basket;

about 400 yards southeast of Kings Point, immediately westward of Monkey Point, and westward of Lower Hastings Buoy.

Tidal signals.—On the bank of the river $\frac{1}{2}$ mile below Kings Point, southeastward of Rangoon, a semaphore indicates the tidal rise above low water, spring tides, as follows, the signals as given being when seen from the southward and show the reverse way in Rangoon Reach:

0	1	2	3	4	5 FEET
6	7	8	9	10	11 FEET
12	13	14	15	16	17 FEET
18	19	20	21	22	23 FEET

A lower arm of the semaphore shows each rise of 3 inches of tide above zero, thus: Arm upward, 3 inches; arm horizontal, 6 inches; arm downward, 9 inches.

A red flag at the peak denotes that tidal signals are not being shown.

Traffic signals.—A black ball, hoisted at the semaphore station, indicates that a sea-going steam vessel is proceeding into harbor; a cross that a sailing vessel is doing so; and a triangle that a sailing vessel is being towed into harbor.

Tides.—It is high water, full and change, at the port officer's wharf, Rangoon, at 4h. 36m.; springs rise 19 feet, neaps 14 feet,

during the dry season, December to April; but during the rains, springs rise 21 to 24 feet.

Tidal streams.—The rate of the tidal stream is from 5 to 6 knots at springs.

Inner navigation.—For the navigation of the Irrawaddy above Rangoon, see page 359.

Rangoon, the chief city and port in Burma, is 21 miles from sea by the course of the river. The city, with the suburbs of Kemmenedene and Pazundaung, lies on the north bank, and behind the array of wharves and warehouses are the buildings of the mercantile or business quarter, from which the ground slopes upward, through a wooded cantonment, to the fort of a slight eminence crowned by the great gilded Shwedagon Pagoda. On the south bank are the suburbs of Dala, Kamakasit, Kanaungto, and Seikgyi, a narrow strip of dockyard premises and native huts.

The city contains several handsome buildings, among which are the Government House, the Roman Catholic Cathedral, the Jubilee Hall, the Town Hall, the college, the general hospital, etc., and in 1911 had a population of 293,316; it is at present lighted with oil lamps, but electric light will probably be introduced at an early date.

Communication.—The British Indian Steam Navigation Co. has weekly services of steamers between Rangoon and Negapatam, calling at Madras and other ports; with Calcutta, Penang, and Singapore; with Calcutta, via Chittagong and other ports; with Cocanada, calling at intermediate ports; and with Tavoy and Mergui; they have also fortnightly steamers to Bombay, via Colombo. River steamers run weekly to Mandalay and fortnightly to Bhano, the limit of steamer navigation, 800 miles from the sea.

It is the terminus of all the railway lines in the Province. The lines to Prome and Bassein Pass westward between the municipality and the cantonment, with several stations within the city limits, and frequent local trains.

The main line to Mandalay and Upper Burma runs generally eastward from the terminus, and, skirting the side of Pazundaung Creek, passes northeastward into Hanthawaddy District.

An electric tramway runs east and west through the heart of the business quarter and northward to Shwedagon Pagoda.

Telegraphic communication with all parts.

Radio station.—A radio station, open to the public at all times, has been opened at Rangoon; call letters V. T. R.

Weather reports can be obtained on application.

Coal and supplies.—About 30,000 tons of coal are kept in stock and about 220,000 tons are imported annually. Coaling is carried on from lighters or boats, as the coal jetty will only accommodate small craft, and from 500 to 1,000 tons can be put on board in 24 hours. The

Burma Oil Co. keeps about 20,000 tons of liquid fuel in stock, and 150 tons could be pumped in an hour.

Supplies of fresh meat, vegetables, and bread can be obtained, and water from a tank vessel or at the port officers' wharf.

Patent slip.—See Appendix I.

Wharves.—Alongside Brooking Wharf the depth is 25 feet at low water springs; at Phayre Street Wharf, 20 feet; at Soolay Pagoda Wharf, 24 feet; at Latter Street Wharf, 21 feet. These wharves are under the port commissioners, and are connected with the railways.

Repairs.—Large repairs can be made to hull, machinery, and boilers by the Irrawaddy Flotilla Co. (Ltd.), who have sheers capable of lifting 10 tons.

Hospital—Sailors' home.—There is a hospital to which seamen are admitted and a sailors' home.

Time signal.—The time signal, made from the square tower of the Mayo Marine Institute, at an elevation of 81 feet above high water, consists of a black ball, hoisted close up at 11h. 55m. 0s. every day, except Sundays, is dropped at 0h. 0m. 0s. Rangoon mean time, which is equivalent to 17h. 35m. 20s. Greenwich mean time.

A gun is also fired (Sundays excepted) at noon Rangoon standard time, which is 5m. 20s. before Rangoon mean time; it is situated close to the time signal. If the ball is incorrectly dropped, it will be hoisted to the masthead immediately, or if it fails to drop, it will remain at the masthead, and in either case it will be dropped at 1h. 0m. 0s. Rangoon mean time.

Storm and weather signals are shown from a flagstaff near the customhouse at Rangoon.

Trade.—The exports are rice, teak timber, raw cotton, raw caoutchouc, cutch, rawhides, jade stone, horns, pulse, and paraffin wax. The imports are coal, salt, cotton, both twist and yarn, piece goods.

The city is famous for its carvers in wood and ivory and for the beauty of its silver work; there are about 50 rice mills, 20 sawmills, and a petroleum refinery.

The United States is represented by a consul and vice consul.

Pegu River, which flows into Rangoon River, eastward of the city of Rangoon, rises in the southern slopes of Pegu Voma, and after a south-southeasterly course of about 50 miles to Pegu, where it is 105 yards broad, and is spanned by a bridge, it trends southward for about 15 miles and then southwestward for 35 miles to Rangoon.

At Pegu, in the dry season, the river is almost dry at low tides, when the tiral rise is 4 to 5 feet. On the east it communicates with Sittang River by several channels, that of Paing Kiwon forming a canal between the two rivers; a canal also leaves the Piang Kiwon

some distance east of Kyaik Padaing, and joins the Sittang at Myitkyo.

Bore.—A bore about 3 feet high sweeps up Pegu River, especially in February, March, and April, and its effects are felt at Pegu in the sudden rising of the early flood. During the rains steam navigation is carried on in connection with Toungoo.

Pazundaung Creek also rises in the southern slopes of the Pegu Voma, and after a southerly course of about 53 miles joins Rangoon River just below the city of Rangoon, where its mouth is about 400 yards in width; it is navigable for boats for a distance of about 40 miles. Thirty-five miles above Rangoon it is 50 feet broad, flows between high, steep banks, and has a depth of 3 feet during the dry season, with a tidal rise of $1\frac{1}{2}$ feet; toward its mouth the banks are steep and muddy.

Inner navigation.—Irrawaddy River is full of islands and sand banks, many of which are submerged during the rains, and the left bank then suffers from inundations. The river is navigable at all seasons by steamers drawing 4 feet as high as Bhamo, or some 800 miles from the sea, and during the dry season for steamers drawing 6 feet as far as Thayetmyo, 364 miles from Rangoon.

In the rains steamers and large boats enter the main stream of the Irrawaddy from Rangoon by Panhlaing or Bawle Creeks, but during the dry season it is necessary to descend Rangoon River for some distance and, passing through Bassein Creek, enter the Irrawaddy through the inner part of China Bakir River.

From Mandalay to the junction with China Bakir River, in latitude 17° north, the general width of the Irrawaddy varies from 500 to 3,000 yards, its banks being generally wooded and well defined. No rules can be laid down for its navigation, as changes frequently take place; but the pilots are intelligent and trustworthy.

Two miles below Akaukaung, on the right bank of the river, is a remarkable cliff, covered with images of Buddha carved out of the rock; it is about $\frac{3}{4}$ mile in length and rises 400 feet sheer out of the river, and is the first high land met with when ascending. Here the stream runs with great strength, as much as $7\frac{1}{2}$ knots having been experienced in August.

The river has been ascended in the month of July from Rangoon to Thayetmyo by a vessel drawing 10 feet 2 inches water. The track taken was through Panhlaing Creek, which joins the main river at Yandun, about 60 miles above Rangoon; the same vessel descended the river and reached Rangoon through China Bakir River and Bassein Creek. The navigation of the main stream in July was easy, and there was sufficient water in it for a vessel drawing 15 feet.

Routes.—To reach the main river from Rangoon the route by Panhlaing Creek is recommended when ascending the river, as it is 67 miles shorter than that by Bassein Creek, and has a depth of about 15 feet in July, or at an average high flood, but only about 7 feet during the dry season; the creek is, however, narrow and intricate, and at the point of junction with the main stream is so tortuous that only steam vessels fitted with twin screws or large additional rudders could turn. Panhlaing Creek is not used by steam vessels when descending the river, on account of the difficulties at this point.

The route by China Bakir River and Bassein Creek is used by large steam vessels on their downward trip, being much less obstructed than Panhlaing Creek and having almost always a sufficient depth of water for vessels drawing not more than 6 feet, at high-water neaps.

Bassein Creek dries in many places at low water, but by entering at the proper time of tide a vessel drawing 8 feet can get through without stopping, as the tidal stream appears to separate about halfway through, so that if a vessel entered with the flood at either end and proceeded as the water rose over the shoal parts, maintaining a speed of 6 knots, the other end would be reached with the first of the ebb.

It is high water 50 minutes earlier at the western end of Bassein Creek than at the eastern entrance. During the last quarter of the flood and first hour of the ebb the stream runs westward throughout the creek, after which, however, the streams separate and flow out of both ends.

There are two other routes from seaward up Irrawaddy River, namely, that leading through Bassein River and Thamadine Creek, and that through the entrance to the Irrawaddy proper, which enters the sea at a few miles westward of Krishna Shoal. Of these routes, Thamadine Creek, which is always used by the river steamers, is narrow and intricate, but has a depth of 3 fathoms; it joins the main stream at a little below Hienzada, about 120 miles above Rangoon. The Irrawaddy proper is said to be the straightest and best channel to sea, having a depth of 12 feet on the bar at low-water springs.

Up-river pilots.—Pilots belonging to the Irrawaddy Flotilla Co. have been found trustworthy; the frequent fluctuations of the river can only be followed by the constant observation of local pilots, who are each qualified for districts about 60 miles long. The pilots are mostly natives of Chittagong. Masters of Irrawaddy Flotilla Co. pilot their vessels as far as Danubyu; thence to Bhamo, local pilots are employed.

Stream.—The average rate of the stream above tidal influence is 3 knots an hour, but at some points it attains a rate of 5 to 6 knots.

Rise of river.—The tide is felt as far up as Henzada, about 120 miles above Rangoon City. In March the river commences to rise, and it attains its maximum height in September, at which time it is, at Prome, about 34 feet above its dry-season level. At Thayetmyo, after the first rise of the river in the early part of July, 1881, the water was 7 feet below the mean high level; it then fell 7 to 8 feet for 13 days, when it commenced to rise again. In 1877 the river is said to have risen 9 feet above the mean high level, the highest rise recorded. The rise varies, being sometimes greater at Prome than at Thayetmyo, 50 miles above; but generally it decreases below and increases above Prome.

At Thayetmyo the river is about 3 miles broad, and the bank, as a rule, so steep that vessels can lie sufficiently near to admit of hauling a boat to and fro by a line; care must be taken to keep clear of snags, which may project from the bank at a few feet below the water.

Up-river trade.—The Irrawaddy Flotilla Co., with headquarters at Rangoon, owning 75 steamers, 11 launches, and 150 flats and barges, maintain the great bulk of the trade. The following are the stopping stations between Rangoon and Mandalay: Yandun, Danubyu, Henzada, Yea-ghin, Myanaung, Prome, Thayetmyo (military station), Minhla, Magwe, Yenangyaung, Sinbyugyan, Nyaungu, Kuniwa, Pakokku, and Mandalay, about 350 miles above Prome.

The chief articles carried upstream are piece goods, rice, salts, hardware, and silk. The downstream cargo consists of raw cotton, cutch (for dyeing), india rubber, jade, spices, precious stones, timber, earth oil, and cereals. The steamers stop on the downward voyage at Letsambu and Tsagine, in addition to the upstream stopping stations.

China Bakir River flows into the sea through extensive flats of sand and mud, about 4 miles southwestward of China Bakir Light-house.

The coast is well wooded, and the entrance to the river can be made out from aloft by the long compact clump of dark trees on its eastern side, the western end of which appears very abrupt, as seen from seaward when abreast the entrance. Eastward of this clump the trees are much less compact with occasional large gaps.

About $\frac{1}{2}$ mile westward of the western entrance point is a clump of coconut palms and $1\frac{1}{4}$ miles northeastward of the eastern point is the town of Mengalon, with a ruined pagoda, not conspicuous, situated to the westward of it.

The western side of the entrance is wooded, but not so closely as the eastern, and there is a small clump of coconut trees near it, which may be useful for identification.

Both banks are lined with mangroves, and about $2\frac{1}{2}$ miles from the eastern entrance point, or about 8 miles from the 3-fathom contour outside the shoals, the river forks. Bassein Creek leading northeastward into Rangoon River, about 10 miles below Rangoon City, and the other branch, which just inside the fork is partially blocked by an island and shoal water, having a westerly direction.

Anchorage may be obtained in about $3\frac{1}{4}$ fathoms at low water, spring tides, with China Bakir Lighthouse bearing about 48° , distant 5 miles. This position is about 2 miles from the narrows.

Directions.—Although the channel through the sand banks off the entrance to China Bakir River is very narrow at its outer end, a vessel of 15 feet draft can enter with care at high water, spring tides, but the entrance should not be attempted without the channel having been previously buoyed.

Within the narrows the depth of water rapidly increases, and a 327° course, keeping on the eastern side of the river, leads to the fork.

If proceeding northwestward, the deep-water channel is on the northern side of the island at the fork, and after passing close to the point at which the coast trends away northeastward into Bassein Creek, steer across the mouth of Bassein Creek, keeping slightly eastward until the center of the channel is open, when enter, avoiding the extensive mud bank which extends off the southeastern end of the island by keeping nearer to the northern shore. There is a small bank also off the northern point of the channel entrance, but of no great extent, and steep-to.

Rangoon to Thayetmyo.—Route in dry season (about October 15 to June 15).

From Rangoon to eastern entrance of Bassein Creek, 13 miles.

From eastern entrance of Bassein Creek to China Bakir River, 27 miles.

From China Bakir to Thongwa, 46 miles, right bank. Large village. Native supplies available.

From Thangwa to Ma u bin, 7 miles, right bank. Fair-sized village. Native supplies available in limited quantities.

From Ma u bin to Danubyu, 44 miles, right bank. Large village. Native supplies available.

From Danubyu to Zalun, 28 miles, right bank. Native supplies available.

From Zalun to Henzada, 19 miles, right bank. Large town. Supplies available for both European and native troops.

From Henzada to Yea-ghin, 60 miles, right bank. Native supplies available.

From Yea-ghin to Myanaung, 14 miles, right bank. Native supplies available.

From Myanaung to Prome, 60 miles, left bank. Large town. Supplies available for both European and native troops.

From Prome to Thayetmyo, 44 miles, right bank. Large town. Supplies available for both European and native troops.

Total distance from Rangoon to Thayetmyo, 364 miles.

NOTE.—Time taken in above passage in river steamers with two heavy flats, 6 to 9 days. On emergency, with favorable weather and moonlight nights the passage could be done in 4 to 5 days. The down passage from Thayetmyo to Rangoon by the same route can be made in 3 days.

Route in wet season (about June 15 to October 15):

From Rangoon to Mayzali Creek, 23 miles, via Hlaing or Rangoon River.

From Mayzali Creek to Pahlaing Creek, Kattywa, 13 miles, right bank. Fair-sized village. Native supplies available.

From Panhlaing Creek, Kattywa to Irrawaddy River, Nyaundung, 24 miles, left bank. Large village. European and native supplies available in limited quantities.

From Irrawaddy River, Nyaundung to Danubyu, 15 miles, right bank.

From Danubyu to Zalun, 28 miles, right bank.

From Zalun to Henzada, 19 miles, right bank.

From Henzada to Yea-ghin, 60 miles, right bank.

From Yea-ghin to Myanaung, 14 miles, right bank.

From Myanaung to Prome, 60 miles, left bank.

From Prome to Thayetmyo, 44 miles, right bank. (See remarks in dry season route.)

Total distance from Rangoon to Thayetmyo, 305 miles.

NOTE.—Time taken in above passage in river steamers with two heavy flats, 5 to 8 days. On emergency, with favorable weather and moonlight nights, the passage could be done in about 4 days.

In the down passage from Thayetmyo to Rangoon the dry season route is adopted.

Upper Irrawaddy River.—The principal affluents of Irrawaddy River are the Mogaung, Ta-peng, Shwe-li, Maina, Karen, Madava, Myitnge, Mu, Chindwin, Yaw, and Yen Rivers; of these the Chindwin is by far the largest, and although not as deep as the Irrawaddy, drains a large area of country, and on meeting the main stream in about latitude 21° 45' north, doubles its volume.

There are three defiles through which the Irrawaddy flows. The northern, above Bhamo Town, is navigable by boats only in the dry season.

The second defile, 15 miles southward of Bhamo and very picturesque, is 8 miles long and about 160 yards wide at its narrowest part, the greatest depth being 23 fathoms; hills about 900 feet high rise almost perpendicularly on either hand.

The third defile, 35 miles above Mandalay, through which the river flows quietly between two ranges of mountains trending north and south, is 29 miles long, with an average depth of 4 fathoms, and $\frac{1}{4}$ mile wide at its narrowest part.

Thayetmyo to Minhla, about 46 miles by river; the river runs northward for the first 25 miles of this distance (skirting the eastern face of a range of hills 1,200 feet high), when it is divided into two channels by Loungi Island, wooded, $1\frac{1}{2}$ miles in length, with a sand bank projecting from its northern and northwestern sides; the channel, narrow but deep, lies along the western or right bank; care is necessary on account of the eddies that form off two small hillocks opposite the western point of Loungi Island.

The eastern channel, which leads past the town of Senbaungwai, is only navigable in the wet season. There is no town of importance in this reach, Mye dai, 3 miles above Thayetmyo, being deserted.

From Loungi Island to Minhla the river bends considerably, but there is no middle ground, and the course is an easy one, the river flowing between hills from 100 to 300 feet high, half way between Loungi Island and Minhla.

Taung gwen Island, $1\frac{1}{2}$ miles long, with some ancient pagodas on it, lies in the center of the river; the channel is on its western side.

Minhla, situated at an angle of the river on the right bank, had a population of 3,537 in 1901; Kola Kone Fort occupies the heights opposite the town. There is good anchorage where the river opens out between Kola Kone Fort and the town, except south-eastward of the point on which the town is built, where a sand bank exists. Vessels secure alongside the river bank close to a small square fort in the center of the town; trade is considerable, and is probably brought down Yen River. The stream is rapid off Minhla.

Yen River joins the Irrawaddy on the left bank, 7 miles above Minhla, having off its mouth a large low island surrounded by sand banks, on the southern side of which is the channel.

Magwe, 15 miles above Minhla, is the headquarters of the district of the same name, and consists of a group of villages collected round the civil station on the eastern bank, the chief feature, seen from the river, being Myathalun Pagoda, built on a slight eminence; the town has one main street, stretching parallel to the bank, with minor thoroughfares.

The civil station contains the usual offices, with a jail, and barracks for police; in 1901 the population was 6,232.

Large sand banks in front of the town prevent river steamers from going alongside.

Hospital.—The civil hospital has 22 beds.

Minbu Town, nearly opposite Magwe, is also conspicuous by its pagodas and high cliffs. The hills lie well back in this reach except at Magwe and Ta fau zeik, an abrupt rocky point with cliffs 80 to 120 feet high and a pagoda on their summit; the channel passes close to this point, a sand bank extending toward Ta fau zeik Point from the opposite bank narrowing the channel considerably.

Yenangyaung, about 25 miles above Minhla, in 1901 had a population of 3,246; some petroleum wells are situated about 5 miles eastward of the town. From Minhla to Yenangyaung the river continues northward, and 2 miles above the former it opens out considerably, and central low-lying islets and sand banks make the channel intricate; it receives five tributaries, viz, on the left bank the Yen, the Karen 10 miles below, and the Pin 1 mile above Yenangyaung; and on the right bank, Ma River immediately above Minbu and a smaller stream opposite Yenangyaung. The stream is stronger in this reach than in any other above Thayetmyo.

The low central islands and the flats on either bank are covered with elephant grass 8 to 10 feet high; most of these islands cover in August, the grass only showing above the water. Temporary villages are built on piles, and the islands are cultivated during the dry season.

From Yenangyaung to Pagan, a distance of 42 miles in the wet and 50 miles in the dry season, the river trends north-north-westward and northward. The most important places in this reach are Kyabin, near Sinbyugun on the right bank, and Pagan nge and Silli myo on the left bank. The channel crosses the river about every 6 miles, and the breadth between the main banks averages 2 miles; the greatest width of river is between Pagan nge and Silli myo, nearly 4 miles between the main banks.

The bed of the river is filled with extensive flat islands that nearly cover in the freshets, and in the dry season the channel lies between the two large alluvial islands, the main banks being recognized only by the line of large trees showing on either hand; about 10 miles above Yenangyaung and again above Palainmyo, low hills run close down to the river bank.

About 6 to 10 miles eastward of Silli myo a solitary mountain named Paop pa doung rises abruptly and is visible from Magwe up to Myingyan. Some of the bends of the channel in this reach are very sharp, turning almost straight across the river; it is advisable to keep the up-stream side of the channel.

Yaw River, entering this reach 13 miles below Pagan on the right bank, is the only one of importance. It disembogues through a range of hills faced with abrupt cliffs, but in the dry season the entrance is barred by sand banks. Six miles below Pagan the crossings are very crooked.

From Pagan to Myingyan, a distance of 30 miles in the wet and 40 in the dry season, the general trend of the river is north-eastward, and it seldom exceeds 3 miles in width between the main banks, which are low; a small range of hills, lying 3 miles back from the bank southward of Pagan, trends southward for 7 miles. Two conspicuous hills lie about 7 miles south-southeastward of Myingyan, and are in line from 2 miles westward of the town.

Pagan Village, known also as Old Pagan, is near the site of an ancient ruined capital of the Burmese Empire, and the ruins of the walls and traces of the moat may be seen; there are innumerable pagodas in the vicinity, some containing stone sculpture of exquisite workmanship, and interesting terra-cotta tiles. Both here and at Yenangyaung the soil is very remarkable, showing a process of fossilization, the fields and river banks being covered with specimens of fossilized trees.

In 1901 the population of Pagan Village was 6,254.

Nyaungu, immediately above Pagan and on the same side of the river, is recognized by its cliffs, which rise abruptly from the river side to a height of about 100 feet, and are pierced with holes; this place is a calling station for the Irrawaddy Flotilla Co.'s steamers.

Kuniwa and Pakokku, the only villages of any size in this reach, lie on the right bank of the river. In the wet season steamers call at Pakokku, using the channel northward of the island opposite the village. In the dry season the channel lies southward of the island and continues along the southern bank. This bank, a little above Kuniwa, has a rocky foreshore with off-lying rocks, which make it very dangerous; the rocks are buoyed, and a European in the employ of the Irrawaddy Flotilla Co., is responsible for the buoyage. The course, after these rocks are passed, is an ordinary one with two sharp turns before reaching Myingyan, 4 miles below which town is a 6-foot crossing.

Chindwin River, the largest tributary of the Irrawaddy, drains the country 90 miles westward of the right bank of the river, joining the main river 10 miles below Myingyan, some 6 miles above which town the Irrawaddy is connected with Chindwin River by two shallow channels navigable only by boats.

The Chindwin River is between 500 and 600 miles in length, and for more than 400 miles of its course it is navigable for steamers during certain seasons of the year, the Irrawaddy Flotilla Co.'s steamers running the whole year round as far as Kindat, 200 miles

from its mouth, and during the rains as high as Homalin, about 130 miles farther upstream.

Myingyan to Mandalay is a distance of 60 miles in the wet and 65 in the dry season, and the general trend of the river is northward for 22 miles toward Myinmu, then eastward 21 miles to Ava and from Ava north-northeastward 10 miles to Mandalay. The river for the first 15 miles of this reach is narrow, but clear of shoals; the banks are hard, except the flat ground off the north end of Myingyan Town.

Samaikkon is a pilot station on the left bank, a distance of 15 miles from Myingyan; above the village the river widens and the banks become low, the deep channel ultimately following either bank for about 3 miles at a stretch.

Nazum is a pilot station about 24 miles above Samaikkon, on the right bank, near the entrance of Mu River, the mouth of which is dry in January.

Ava, a picturesque former capital of Burma, is situated in an angle where the river turns from eastward to northward in the direction of Mandalay, the remains of the old city being built on a triangular island artificially formed by a channel between the Myitnge and the Irrawaddy; the few houses belonging to it are scattered about in more than two dozen hamlets, inhabited by lacquerers, weavers, and other artisans. The town of Ava lies on the left bank, and from the walls which rise up from the river bank a rocky shoal stretches more than half way across the river toward Sagaing.

Sagaing Town, the headquarters of the district of that name, is picturesquely situated on the right bank, which is here high; it is embowered in tamarind trees, the civil station occupying the southern portion of the river front, while the native quarters lie to the south, north, and northwest of the European. In 1901 the population was 9,643.

The right bank has a large sandflat, projecting from the river, which slopes off toward the east, where vessels can go alongside the bank. A low range of hills, running north and south, and visible from Myin Mu, terminates $\frac{1}{2}$ mile above Sagaing Point; large iron-smelting works lie close to the southern extremity of the hills. Kaongniudhau, a large pagoda, with a nipple-shaped dome, conspicuous from the river, stands on the plain northwestward of Sagaing Pagodas.

Vessels and barges filled with stones, were sunk opposite Ava, to prevent the British advance in 1885, but there is still a channel close to the sandflat off Sagaing and another close to the Ava Shore. Possibly this dangerous portion of the river has been improved and buoyed.

Communication.—There is a steam ferry to Amarapura, and the railway station and steamer ghát are at the northeast corner of the town.

From Ava to Mandalay the channel runs between low-lying islets, and is intricate. Myitnge River, which enters the Irrawaddy at the northeastern salient of the walls of Ava, is navigable for boats drawing 6 feet for over 5 miles; in January the bar at the mouth of the river had only 5 feet over it.

Mandalay, the capital of Upper Burma and the headquarters of the division and district of the same name, occupies a plain on the east bank of the river between it and the Shan Range, the old city, known as Fort Dufferin, being $1\frac{1}{2}$ miles from the river bank; its walls form a perfect square, the sides $1\frac{1}{4}$ miles long.

The palace is in the center of the square, with roads converging from each of the four main gates and bridges over a moat outside, and north and south of the palace are shady pleasure gardens with lakes and grottos; around the palace are the throne room, the council chamber, and the bell and other towers, with many handsome pagodas in the vicinity.

The barracks and officers' quarters are within the fort walls, the Government house overlooks the moat from the north wall, and to the south, outside the walls, are the courthouses, municipal office, and, farther west, the hospital and railway station, while in the west is the business quarter of the city, with post and telegraph offices.

Population.—In 1911 the population was 138,299.

Communication.—Steamers of the Irrawaddy Flotilla Co. run to Mandalay, which has also railway communication with Rangoon, via Toungoo, and lines extend northwest and northeast from it; the latter being in course of construction to Boduayn gold and silver mines.

Amarapura, the headquarters of the subdivision of the same name, is situated on a strip of high ground between the Irrawaddy and Taungthaman Lake, the old city, now covered by cultivation, being on the north side of the lake; it was the capital previous to its being changed to Mandalay. It is connected to its surroundings by a number of brick causeways and wooden bridges, has numerous pagodas in the vicinity, and abounds in tamarind trees and fine mango groves; in 1901, its population was 9,103.

Communication.—It is a station on the branch line which runs from Myonhaung, on the Rangoon-Mandalay Railway, to the river opposite Sagaing, and connected by ferry with the Myitkyina.

Trade.—The chief industries are silk and cotton spinning, weaving, and dyeing, and tobacco, beans, onions, ground nuts, and other crops are grown.

Mandalay to Kubwet, a distance of about 50 miles in the wet and 56 in the dry season; the general trend of the river is northward.

The first 38 miles, up to Singu, the only village of any size with the exception of Sheinmagar, is shallow and irregular, the right bank being straight with low hills nearly to the water's edge, and the left bank having flat islets projecting from it, behind which are numerous creeks and marshes.

In the wet season the right bank is usually followed up to the entrance of the third defile, which commences near Singu.

The Madava discharges into this reach on the left bank 16 miles northward of Mandalay, and forms a bar which carries on it only $6\frac{1}{2}$ feet in the dry season.

A long stretch of shallow water, known as Henjazi Bar, occurs 8 miles farther northward, commencing at little above Sheinmagar; the crossings often have as little depth as 4 feet, and in the driest time of the year cargo and passengers have sometimes to be trans-shipped by boats; Ywathagi Channel, to the westward, used in the wet season, has deeper water in it, but the rocks are said to be numerous, and in the dry season it is not used.

Two or three miles above Singu Hills, covered with tall trees and thick bamboo undergrowth, commence and form the third defile. In this defile the banks are steep and sometimes stony, while the center is deep and clear.

Kubwet is a pilot station, and lies nearly in the middle of the third defile on the right bank, about half a mile westward of where the river takes a sharp trend northward.

Kubwet to Myadaung is a distance of 70 miles, the general direction of the river being northward, continuing through the third or lower defile for about 9 miles to Sabenago, a large village on its right bank, here it widens out to nearly a mile between the main banks and resumes its deltaic character; hills from 400 to 500 feet run down close to the water's edge in this reach on the right bank.

The left bank is flat, though there is a range of mountains 4,000 to 6,000 feet high lying back about 6 miles, and following the trend of the river to about 20 miles southward of Myadaung. The channel is intricate, and there are two sharp crossings, one about 3 miles northward of Sabenago and the other about 12 miles farther north.

Myadaung, a large village, is a calling port and pilot station for vessels of the Irrawaddy Flotilla Co.

Myadaung to Modah is a distance of 45 miles, the general trend being north-northeastward; the character of this reach is similar to the one below it. About 14 miles above Myadaung, on the left bank, is Shweli or Nam Moa, a large river, which meets the Irrawaddy.

From Modah to 6 miles southwestward of it the main banks are from $2\frac{1}{2}$ to $2\frac{1}{4}$ miles apart; the islands that have formed in the bed of the river narrow the channel to about $\frac{1}{4}$ mile in width, the channel lying alternately along each bank.

Modah is a pilot and calling station.

Katha, situated on the right bank, the headquarters of the district of the same name, about 200 miles above Mandalay, contains a bazaar and the usual public buildings, and is laid out along five principal roads stretching north and south, parallel to the river; in 1901 the population was 2,931.

Communication.—A branch line from the Sagaing-Myitkyina Railway terminates here and connects with the steam ferry to Bhamo and the steamers of the Irrawaddy Flotilla Co. running between that station and Mandalay.

Modah to Bhamo, a distance of about 53 miles. From Modah the river trends a little northward of east for 10 miles, then southward past Shwegu, through the pass of the second defile, where it again bends northward and then eastward for 10 miles, when it turns northward toward Bhamo.

The second defile begins a little above Shwegu, off which lies a large low island. About 4 miles from the above place is the pass, composed of a range of mountains from 800 to 2,000 feet high, through which the river flows, making a sharp bend through one of the valleys; the greatest depth found was 23 fathoms. The entire length of the defile is 6 miles, and the scenery is very fine, at one place the cliff rising perpendicularly 600 feet from the water.

In the freshets the eddies are so violent that it is with great difficulty steamers get through the pass, but in the dry season it is a quiet stream.

The character of this reach, with the exception of the defile, is the same as the others; the river is narrower and navigable to within $1\frac{1}{2}$ miles of Bhamo. The only place where there is any trade is at Sinkan, built at the mouth of a small creek, down which the Maungmahtaw timber rafts come to Shwegu and Kongti, both small villages, their inhabitants being Shans and a few Chinese.

Bhamo, the headquarters of the district of the same name, extends along the left bank of the Irrawaddy for nearly 4 miles, the houses being ranged on two long roads parallel to the river, behind which is the maidan.

The Shan quarter is in the southern part, and on the southern edge of some higher ground extending eastward from the river are the hospital and the district postal and telegraph offices. The Chinese quarter and Burmese village are farther north, the latter stretching to the military barracks; in 1901 the population was 10,734.

The town is not so subject to malarial fever as previously, owing to some of the backwaters having been drained.

A range of mountains similar to those near Mandalay lies some 10 or 15 miles eastward of the town, the plains coming close up to their bases. These hills are peopled by the Kachens, a small but vigorous tribe.

The chief exports from Bhamo are furs, rubies, raw silk. The principal imports are salt and cotton goods.

Irrawaddy River—Banks, channels, etc.—The main banks of Irrawaddy, generally distinguishable by high trees, pagodas, etc., are as a rule stationary, but the shapes of the flat alluvial islands and banks facing them are constantly being altered by the streams. The channel rarely keeps to the same bank for more than 3 miles, a small projection from the bank being sufficient to deflect the water toward the opposite side; obstructions under water often exist, and cause the crossing to assume an S shape; this is the most difficult form of crossing, for which no guide can be given.

Great experience is requisite in navigating the river.

The cutting away of the banks is one of the best guides for ascertaining the channel, for as the water impinges on the bank, it crumbles away and falls in; the point of greatest cutting is often indicated by flocks of crows and gulls, feeding upon the insects thus exposed, whilst, floating off in mid-channel, are drift and earthy bubbles.

The bubbles exist over any depth according to their size, from 2 feet diameter over 3 to 5 feet water, up to 8 feet over a depth of 2 to 3 fathoms. As a rule the deep water shows the fastest surface stream; the pilots, coming down the river, watch the play of light on the water to detect the curves that the rapid moving is taking, through the dead water of the shallows.

A vessel should keep to the up-stream sides of the crossings, so that in case of grounding she may swing off into deeper water.

Climate.—The cold season begins about the middle of November at Thayetmyo, the mornings and evenings being cool, the former sometimes foggy. From November to the middle of February the weather is fine and pleasant, especially between Mandalay and Bhamo. The nights are cold, and a strong breeze sets in about 1 a. m., that should be guarded against; often, as the wind drops, a thick fog comes on that lasts up to 10 to 11 a. m. The rainfall at Bhamo is reported to be heavy, and moderate at Mandalay, the lowest temperature observed on the 1st of January at Bhamo was 52°; it has been known to fall there to 45°.

River levels.—The following observations show the difference of the river level in the wet and dry season: Danubyu, on the 18th of January, 24 feet; Henzada, on the 17th of January, 30 feet; Thay-

etmyo, on the 16th of January, 35 feet; Yenangyaung, on the 14th of December, 17 feet.

Estimated fall of the river at Pagan, on the 22d of November, 14 feet; Mandalay, on the 10th of January, 12 feet; 20 miles above Mandalay, on the 4th of December, 8 feet; in third defile, on the 4th of December, 10 feet; in second defile, on the 28th of December, 9 feet.

The river fell 8 feet at Pagan between November 24 and January 13; 6 feet at Thayetmyo between November 2 and 12. It is reported to fall a foot daily at the end of October.

Gulf of Martaban.—The Gulf of Martaban is nearly 125 miles in width between the southeast extreme of Pyapon Island, on the west, and Ku-la-gauk Island off the Amherst coast, on the east, and extends northwards for a distance of about 90 miles to the shoals off the entrance to Sittang River.

The gulf is shallow throughout, the 10-fathoms contour being nearly on a line joining the two places above mentioned, inside which the water shoals gradually, the 5-fathoms contour being roughly half the distance to its head.

Anchorage.—There is anchorage anywhere in the Gulf of Martaban, where the depth of water will permit, but before anchoring the direction of the tidal stream should be ascertained, and very little cable be given until the vessel is head to it, when the necessary amount may be gradually veered.

Sittang River.—The coast eastward of the entrance to Rangoon River is low, and bordered by an extensive shallow bank of mud and sand, which prevents its being approached. Sittang River, at the head of the Gulf of Martaban, has a wide bell-shaped mouth; there is no chart of its channels, and it is only entered by local trading craft.

The Sittang River, sometimes named Paunglaung or Toungoo, rises eastward of Yamethin District, in about lat. 20° N., and, winding through Toungoo District, after a course of about 350 miles falls into the Gulf of Martaban.

It is connected at Myitkyo, a village on its lower reaches, with Pegu River by the Pegu-Sittang Canal, and further southward, at Mopalin, with Kyaikto and other portions of the Thaton District by the Sittang-Kyaikto Canal, both canals primarily intended for navigation. Bridges are in course of construction at Toungoo and at the point where the railway to Moulmein crosses it.

Above Sittang Town the stream is so strong that this part of the river is scarcely navigable by the large native boats. During the rains communication with Moulmein (by boat) is kept up through Wengbadaw Creek, the entrance to which is about 7 miles below Sittang Town.

On the eastern side of Sittang River Entrance are Zingyaik Mountains, which are about 9 miles inland, and extend in a northeasterly and southwesterly direction, having several pagodas on their summits, the northern of which is the highest; these mountains are sometimes visible for a distance of upwards of 50 miles, but are of little aid to navigation, being too far inland.

Communication.—Toungoo is connected by railway with Rangoon and with Mandalay.

Tidal streams.—On the coast of Irrawaddy and Pegu the tidal streams have considerable velocity, the flood stream setting eastward, and the ebb westward when to the westward of Baragua Flats; abreast of these flats and farther westward the rate of the tidal streams, especially the flood, is not so great as eastward of them.

From Baragua Flats to Rangoon River Entrance, the flood sets north-northeast and northeastward, and the ebb southwestward. Between Rangoon River and Moulmein the flood sets into the Sittang River in a north-northeast and northerly direction on the Rangoon side, and north-northwestward on the Moulmein Coast.

The general direction of the flood stream in the Gulf of Martaban is north-northeastward, becoming more northerly as the eastern side is approached, and following the trend of the coast within a distance of 10 miles. The ebb stream in all parts of the gulf sets almost invariably in the reverse direction to the flood.

The rate of the streams is not much seaward of the 20-fathoms contour line; in that depth its rate is from 2 to 3 knots an hour at springs, which increases to 4 knots in latitude 16° N., and northward of this the streams are rapid running from 6 to 7 knots in latitude $16^{\circ} 15'$ N. During and immediately after the Southwest monsoon, the ebb streams are much stronger and run longer than the flood.

The duration of slack water at springs is very short, not exceeding $\frac{1}{2}$ hour, and there is little difference in the direction of either stream at different times of tide in any part of the gulf.

A bore sweeps up Sittang River at spring tides; following it, and said to be as dangerous as the bore itself, is a chopping sea of sand and water. The Sittang has an enormous quantity of silt suspended in its water.

Thaton District.—From the eastern side of Sittang River Entrance the coastline of Thaton District has a general southeast direction for nearly 60 miles to the west side of the entrance to Moulmein River.

Balugyun Island.—The coast eastward of the Sittang Entrance is low, and trends south-southeastward to the entrance of Martaban River, the northern mouth of the Salween, between which and Moulmein River, the southern mouth, lies Balugyun Island, $17\frac{1}{2}$ miles in length in a north and south direction, and 8 miles in greatest width.

A range of wooded hills, from 450 to 575 feet high, extends north and south throughout the northern half of the island; and there are several lower detached hills in the southern part of the island. The population in 1901 was 41,880.

Kwang la Pagoda (Konla), on the southeast side of the island, is situated on a hill 183 feet high, and, together with two others on the south coast of the island, form good marks in approaching Moulmein River.

The western coast of Balugyun Island requires a wide berth when approaching from northward, to clear the shallow water off it.

Moulmein or Salween River rises in unexplored country to the eastward of Tibet, and flows from north to south, entering British territory at about the 24th parallel north. Thence bisects the Shan States and Karenni; after passing the southern limit of the latter it forms the boundary between Siam and the Salween District, and then passes down the center of Thaton District, and, after flowing for 650 miles through British territory, discharges into the Gulf of Martaban below the wooded heights of Moulmein.

Ten miles below its junction with the Taungyin, a tributary, are the great rapids, formed by a bridge of rocks extending completely across the river, which are impassable in the dry season, even by canoes. Ten miles farther down the river there are less formidable rapids, but impassable in the rains, and below which the river is encumbered by numerous islands and shoals, which are covered in the rains, when the water rises about 30 feet.

A few miles farther southward it receives the waters of the Rwonzaleng from the westward, and hereabouts the hills on the left bank recede, those on the right diminish considerably in height, and the river traverses a more open and level country. Limestone rocks, rising suddenly out of the plain into serrated lofty ridges, appear on both banks at intervals.

At Moulmein the river receives from the eastward the Gyaing, formed by the junction of the Hlaingbwe and the Haungtharaw, and from the southeastward by the Ataran. It here splits and enters the sea by two outlets. Martaban or Darebauk River, the northern of which, in about latitude 16° 30' north, was the principal entrance, but is now filled with small islets and sand banks; and Moulmein River, the southern and navigable entrance. On its right bank, and opposite Moulmein Town, is Martaban Town.

Although, owing to its narrow rocky bed and frequent rapids, it is practically useless for the purposes of through navigation, it is greatly utilized for timber floating, and quantities of teak are sent down annually.

It is not bridged in British territory, but is crossed at intervals by ferries, the most important of which are Kun Long, Taw

Kaw (Kaw Ferry), Taw Maw Ferry in Karenni, and ferries at Kyaukhnyat and Dagwin in Salween District.

Tounzoun Point, the south point of Balugyun Island and the northern entrance point to Moulmein River, is the extremity of a ridge about $\frac{1}{2}$ mile in length in a north and south direction, and 170 feet high toward its northern end, lowering toward the point; there are several pagodas about the ridge, and Kwang la (Konla) Pagoda, about $1\frac{1}{4}$ miles northeastward of it, has been already mentioned as forming a good mark.

Amherst Point, the southern entrance point to Moulmein River, terminates in a bluff point 60 feet high, the coast southward being low cliffs; on the extreme point is an old pagoda. About 200 yards northwestward of Amherst Point is the Water Pagoda, a conspicuous building on piles surrounded by water at half tide, and on the rocky point, 1 mile to the southward, above the cliff, 40 feet high, is another pagoda which has a small pagoda close to it surrounded by water at high tide.

Signal and telegraph station.—A flagstaff is situated on Amherst Point, and the signal station, which is the property of the Indian Telegraph Department, can signal messages or orders by means of the flags of the International Code.

Green Island, 1 mile south-southwestward of Amherst Point, is 145 feet high and covered with trees and brushwood, with a clump on its summit; it is surrounded by a bank with rocks and boulders on it, and it should not be approached within a distance of $\frac{1}{2}$ mile.

Light.—On Green Island, from a square tower of masonry 65 feet in height, painted red and white in horizontal bands, a flashing white light is exhibited at an elevation of 135 feet above high water, visible 17 miles. (For details see Light List.)

Tsheng Taung (Sendong), a wooded hill 934 feet high and $4\frac{1}{4}$ miles southeastward of Amherst Point, is conspicuous from the westward.

Entrance.—The entrance to the river, between Tounzoun and Amherst Points, is 9 miles wide, but much encumbered by extensive sandbanks, which dry at low water, and some reefs.

Dangers.—The southwest side of Balugyun Island is fringed by a mud bank, which dries with shoal water outside it, the whole extending to a distance of about $\frac{3}{4}$ mile, but westward of Tounzoun Point it is about $2\frac{3}{4}$ miles offshore, and the southwest extreme of this shoal water is 3 miles southwestward of the point, from which extreme the edge has an east-northeast direction, skirting the southern coast of the island at a distance of about $1\frac{1}{2}$ miles, where immediately inside the edge of the shoal water is a bank of sand and mud, which dries in places from 10 to 12 feet.

Buoy.—A can buoy, painted black and surmounted by a staff and cage, marks the south extreme of the shoal extending from Balugyun Island, and is the northern entrance buoy to New Channel.

Balugyun Sands, occupying nearly the center of the entrance between Tounzoun and Amherst Points, is a large square-shaped bank, $2\frac{1}{2}$ miles in extent, which dries from 6 to 10 feet in places; its sea face, lying in line with the coast, and in nearly a north and south direction, at the mouth of the river, is so steep to that the lead gives no indication of approach to it.

It is separated from the shoal extending southward of Balugyun Island by New Channel, and eastward of Balugyun Sands are a number of smaller patches, which dry and almost completely fill the river to the east bank; their positions will be seen on the chart, but no navigable channel exists between them.

Buoys.—A conical buoy, painted red and surmounted by a staff and cage, is moored $\frac{1}{4}$ mile off the northwestern point of the shoal of Balugyun Sands, and is the southern entrance buoy of New Channel.

A red conical buoy, marked "G. S." in white, carrying a red globular cage, and known as the Goodwin Sands Buoy, is moored in a depth of about 30 feet, on the western side of Balugyun Sands, 2 miles southward of southern entrance buoy of New Channel.

Goodwin Sands, two small, narrow patches, the southern of which dries 7 feet, lie about a mile southeastward of Balugyun Sands.

Longstones Reef.—From Amherst Point a reef of rocky patches, with deep water between them, extends northwestward for a distance of $1\frac{1}{2}$ miles. The outer rocks of the reef cover when the tide has risen 9 feet above low-water mark, but the highest do not cover until the tide has risen 12 feet. The channels between the rocks should not be attempted, even by a boat, without local knowledge, except at slack water.

The Patch, on which there are general depths of from 9 to 16 feet, but less than 6 feet on a rock on its eastern edge, is 800 yards long in an east and west direction, and 400 yards north and south; its outer endge, with a depth of 11 feet, lies 2 miles west-northwestward of Amherst Point, and it is nearly joined by shoal water to Longstones Reef.

Buoy.—A conical buoy, painted red and surmounted by a staff and cage, is moored in a depth of 30 feet 500 yards southward of the western extreme of the patch.

A shoal 300 yards in extent, with 34 feet water over it, lies about 1,600 yards westward of the buoy.

New Channel.—The channels into Moulmein River are constantly altering, as, instead of the channel which is now between the south side of the shoal water and drying patches southward of Balubun

Island and the northern side of Balugyun Sands, the river was entered in 1877 southward of Balugyun Sands. The entrance between the extreme point of the shoal, 3 miles southwest of Tounzoun Point, and that extending northwest of Balugyun Sands is a $\frac{1}{2}$ mile wide, narrowing to about 100 yards in parts of the river.

Depths.—The river is generally navigable from the sea to Moulmein for vessels of 25 feet draft at high water, spring tides, and of 18 feet draft at high water, neaps.

The depths in the channels to Moulmein vary considerably, and the bars are constantly shifting. The least depth of water on the various bars, from the last information, is, on Balugyun Crossing, 14 feet; Amelia Crossing, 8 feet (1900); Sirrocca Bar, 14 feet.

In consequence of the frequent changes and the rapid tidal streams setting in places across the channel, entrance into Moulmein River should not be attempted without a pilot.

Pilots.—The pilot station is at Amherst Point, and a pilot will be sent off on the pilot signal being made by day, or if a blue light is burnt at night, but entrance into the river is impracticable, except during daylight. Vessels over 200 tons are obliged to take a pilot.

Tug.—A tug is available, but it is old and of small horsepower.

Quarantine.—Vessels from an infected port, or having had sickness, or over two deaths on board during the voyage, or having plague on board, or those on board which plague has occurred within the preceding 12 days, should hoist a yellow flag, or being an infected or suspected vessel shall hoist, by day, the code flag over flag L of the Commercial Code, which is a square flag of yellow and black borne quarterly, and by night three lights, at a height of not less than 20 feet above the hull of the ship, which shall be arranged at a distance of not less than 6 feet apart in the form of an equilateral triangle, and of which the light at the apex of the triangle shall be white, and the lights at the end of the base shall be red.

There must not be any communication between such vessels and the shore or any other vessel or boat, except to receive the pilot, his servant and baggage, until permission is granted in writing by the health officer.

If there is a suspected case of plague on board or if more than two deaths from any cause have occurred during the voyage, the pilot anchors the vessel off North Beacon, below Lower Anchoring Creek, to await the health officer; in other cases vessels are anchored at the north end of Mopun Island. The segregation camp for plague is at Lower Anchoring Creek.

Vessels which have, within a period of two months immediately preceding their arrival, started from or touched en route at a port infected with yellow fever or communicated (except orally without contact, or by signal) with a vessel which is either infected with yel-

low fever or which has left a yellow fever infected port within that period, shall be allowed to anchor only, at a point 1 mile southwestward of Green Island.

Outer anchorage.—The best anchorage and the most convenient position for pilots to board vessel at all seasons is in depths of from 9 to 10 fathoms, over mud, with Green Island bearing 46° distant 1.2 miles.

Off Amherst Point and northwestward of the Patch Buoy the bottom is foul, and the holding ground bad; the tidal streams are also very strong.

Amherst.—Just inside Amherst Point is the small village of Amherst, containing only a native population. It has a good circuit house, which is often visited by Europeans from Moulmein for sea air and bathing.

Anchorage.—There is a small snug anchorage inside Longstones Reef and northward of Amherst Point, but owing to the intricate channels through the reef, it is never visited by larger craft than those which can cross the flats eastward of Balugyun Sands.

Communication.—There is a mail service by steam launch three times a week between Amherst and Moulmein, and a post and telegraph office on the point, in connection with Moulmein, distant 56 miles, by a good carriage road.

Directions—Bay of Bengal to Moulmein.—After passing Alguada Light steer to make Baragua Flats and Krishna Lightvessels, and from a position with Krishna Lightvessel bearing 1° distant about 8 miles, the depth then being from 14 to 16 fathoms, shape a course about 78° for Double Island Lighthouse, distant 110 miles, and, having approached Double Island to about 3 miles, steer about 1° from Amherst Point.

In thick weather, during the southwest monsoon, should the position of the vessel be doubtful, keep well to the southward and make the land a little southward of Kulagauk Island. With bad weather, particularly at or near spring tides, do not proceed to the anchorage off Amherst, but pass inside Kulagauk Island and anchor in Bentinck Sound, described later.

In clear weather, and often on a bright moonlight night, the high mountains in the interior, eastward of Double Island, may be sighted before the lighthouse or light.

As the land near the river is seldom seen at a greater distance than $\frac{1}{2}$ mile during March, the land must be made well to the southward and the position off Double Island ascertained before steering for the river.

Vessels frequently get on shore at Balugyun Sands in fogs, in consequence of keeping too far to the northward; the lead gives no warning of approach to the banks, which are steep-to.

Having made Double Island or its light, steer to pass a convenient distance outside it, and Green Island Lighthouse or Light should be sighted before the vessel is abreast of Double Island. Do not bring Double Island Lighthouse or Light to bear southward of 153° until Green Island Lighthouse or Light bears 46° , when steer for it, and when Double Island Lighthouse bears 164° anchor in from 9 to 10 fathoms water, as previously directed.

Caution.—When standing to the northward the position of the vessel must be constantly checked by bearings of Double Island Light, to prevent being set in toward the land, until close to the dangers in the entrance to the river.

In the event of the lightkeepers at Double Island requiring assistance they have instructions to darken the light for a short interval when a steamer is sighted, and, as fever is prevalent on the island, this happens occasionally, and should be reported.

Rangoon to Moulmein.—In shaping course allow for the tidal streams; great attention must be paid to the lead, and the soundings considered with the chart. In fine weather, the lofty, sharp, conical peak of Zingyaik Mountains, the high land of Balugyun Island, and Tsheng Taung may be seen on approaching the river. In thick weather, especially in February, March, and April, as Balugyun sands are steep-to and soundings give no indication of their vicinity, it is advisable to make the land between Button Island and Krapo Island.

A good lookout must be kept and caution used in approaching the land, as soundings give no indication, and rocks and shoals extend $\frac{3}{4}$ mile off the coast. The local steamers plying between Rangoon and Moulmein make Balugyun Island, but they are of light draft and high speed.

Tides.—It is high water, full and change, at Amherst at 2h. 21m., springs rise 20 feet, neaps 13 feet; at the New Channel at 2h. 41m., springs rise 22 feet, neaps 13 feet; at Anchoring Creek at 3h. 1m., springs rise 18 feet, neaps 11 feet; at Natmu at 3h. 21m., springs rise 17 feet, neaps 10 feet; and at Moulmein at 3h. 41m., springs rise 14 feet, neaps 7 feet, and neaps range 6 feet.

The tidal rise above given is approximate only; very complete and reliable tidal data is given in Tide Tables for Indian Ports, published by the Government of India.

Tidal streams.—In the offing at Amherst the flood or north-going stream commence about half an hour after low water at Amherst Point, and the ebb or south-going stream about half an hour after high water there; the streams run $3\frac{1}{2}$ knots at springs, and about 2 knots at neaps, and there is very little slack water.

Outside Moulmein River entrance the flood stream sets northward along the coast, the ebb from about west-southwest at the second, to

south at the fourth hour; and the rate of the stream, augmented on the ebb by the water from Sittang and Salween Rivers, is very great. Off the entrance to Moulmein River the flood stream sets toward Longstones Reef; and when the outer banks are covered, it sets strongly eastward over the sands. The streams within take various directions through the numerous channels between the banks.

In the river during the dry season the greatest rate of the stream is about 3 knots an hour, but in the wet season its rate is much greater, and in August the river is much swollen by rains, the tide rising 26 to 28 feet, and the stream attaining a rate of 7 knots an hour.

The streams turn approximately during the dry season as follows:

Off Green Island, flood stream begins at low water at Amherst; ebb stream, half an hour after high water at Amherst.

Off New Channel Entrance, flood stream begins 1h. 40m. after low water at Amherst; ebb stream, 1h. 30m. after high water at Amherst.

At Lower Anchoring Creek, flood stream begins 2h. 20m. after low water at Amherst; ebb stream, 1h. 30m. after high water at Amherst.

At Natmu, flood stream begins 3h. 10m. after low water at Amherst; ebb stream, 1h. 40m. after high water at Amherst.

Off Moulmein, flood stream begins 3h. 30m. after low water at Amherst; ebb stream, 1h. 50m. after high water at Amherst.

The local authorities state that the durations of the flood and ebb streams are the same all the year round at Amherst, but at Moulmein their duration is, approximately: October to January, 4 hours flood, 8 hours ebb; February to May, 5 hours flood, 7 hours ebb; June, 3 hours flood, 9 hours ebb; July to September, no flood, except at height of springs.

Moulmein River—Buoyage.—The channel of the river is marked by red buoys on the starboard hand and black buoys on the port hand, entering, the two outer buoys having a staff and cage, and the only directions that can be given are to pass between the buoys.

Balugyun Crossing had 14 feet least water over it and is the narrowest and sharpest crossing in the river, the tidal streams setting strongly across it. It is reported to be narrowing, shoaling, and gradually edging farther southward.

Amelia Crossing had a depth of about 12 feet and the tidal streams set obliquely across it; it was reported (1900) to have shoaled to 8 feet; both these crossings are buoyed.

Middle Ground, westward of the northern part of Mopun Island, has a depth of 9 feet over it.

Buoy.—Middle Ground is marked by a conical buoy, painted black and white in horizontal bands, which can be passed on either side.

Sirrocca Bar, the depths on which are constantly changing, had 11 feet water on it in 1899 and 14 feet in 1900. The port office flag-

staff in line with the eastern fall of the Duke of York's Nose, a remarkable hill northward of Moulmein, bearing 8° , leads over the bar in the deepest water.

Sirrocca Rock, with less than 6 feet water on it, lies nearly in the center of the river north of Sirrocca Bar.

Buoy.—A conical buoy, painted black and white in horizontal bands, is moored in a depth of 14 feet 100 yards southwestward, of the rock.

Anchorage.—There are anchorages in the river at the following places, but vessels must moor, as in no case can they lie at single anchor.

North Beacon Anchorage.—North Beacon is situated on the east bank, nearly $2\frac{1}{2}$ miles eastward of the south point of Long Island, and there is good anchorage in from 20 to 30 feet water, clear of the fairway off the beacon, and between it and the tide gauge. This is the quarantine anchorage.

Natmu is on a point of the west bank about $1\frac{1}{2}$ miles northward of the north end of Long Island, and good anchorage may be obtained in from 25 to 35 feet, $\frac{1}{2}$ mile southward of Natmu.

Mopun Anchorage.—The deepest anchorage in the river extends from the northern end of Mopun Island to Sirrocca Bar; at its southern end the depths are about 35 feet, and at the northern end 8 to 10 fathoms, the anchorage being about 700 yards westward of Mopun Pagoda, which is a good berth for large steamers wishing to avoid crossing Sirrocca Bar.

Moulmein Anchorage, off the town, in depths of from 30 to 40 feet, is more roomy than Mopun Anchorage.

Directions.—The channel, entered between the south point of the shoal extending 3 miles southwest of Tounzoun Point and the northwest extreme of Balugyun Sands, takes an east-northeasterly direction, passing $1\frac{1}{2}$ miles southward of Balugyun Island and $2\frac{1}{4}$ miles southward of Long Island; it then bends to the southeastward for about 1 mile to Balugyun Crossing, when it turns sharly northward, requiring care in large vessels.

From Balugyun Crossing the channel follows the east bank until a mile above Halfway Creek, where it turns west-northwestward over Amelia Crossing, and passes along the east coast of Long Island for a short distance, then follows almost mid-channel of the river to the south point of Mopun Island, taking along the east side of that island until about $\frac{1}{4}$ mile southwestward of its northern point, when its course is along the western bank to New Island, from which it crosses Sirrocca Bar to the anchorage off Moulmein.

Owing to the great changes invariably occurring, after every monsoon, both in the banks and in the river bed, implicit reliance should not be placed on the plan of the river and its approaches.

Port of Moulmein.—The port of Moulmein commences about 24 miles from the entrance to the river, after Sirrocca Bar has been passed, and extends for a distance of about $2\frac{1}{2}$ miles to Battery Point, northward of the town, with breadths of from 400 to 800 yards. The port is in charge of a port officer belonging to the Royal Indian Marine.

Dangers.—Wales, Castle, and Town Rocks, the first two on the eastern and the last on the western side, have less than 6 feet water over them, and are outlying dangers in the port.

Buoys.—A conical buoy, painted red, is moored at a distance of nearly 200 yards south-southwestward and northwestward, respectively, of Wales and Castle Rocks, and the northeastern side of Town Rock is marked by a conical buoy, painted black.

Wharves.—There are six pontoon wharves or jetties, the four northern being Rangoon, Main, Cohens Wharves, and Kaladan Jetty. Mission Street Jetty has 16 feet alongside it at low-water springs, and Main Wharf $11\frac{1}{2}$ feet, the latter being used by the steamers plying to Rangoon.

Storm and weather signals.—The usual storm signals for India and weather signals for the Bay of Bengal are exhibited from the port-office flagstaff.

General signals.—The following signals are made at the port office and hill flagstaffs:

British naval vessel, white ensign.

Foreign naval vessel, blue flag, yellow border.

Indian Government vessel, blue ensign.

Transport with troops, red ensign.

A steamer, blue flag, with white cross.

British India Steam Navigation Co.'s steamer from Calcutta and Rangoon, blue pendant.

British India Steam Navigation Co.'s steamer from Singapore, rendezvous flag.

Coasting steamer from southward, red, yellow, blue, horizontal, pendant.

Tavoy and Mergui mail, pendant with red ball.

British India Steam Navigation Co.'s steamers (other than above), white flag with red cross.

Asiatic Co.'s steamer, blue, white, blue, horizontal, flag with blue star in center.

Sailing ship or barque, ball at yard arm.

Brig, schooner, or native craft, triangle at yard arm.

A ball below the signal indicates European mail by whatever steamer it may come.

A gun is fired by the steamer with English mails when passing Mopun Point.

Time signal.—A gun is fired daily (Sundays excepted) at noon, Burma standard time, but it is only approximately correct and must not be used for rating chronometers.

Moulmein, the headquarters of the Amherst District, is situated amongst beautiful scenery on the left bank of the river, 25 miles from the sea, and occupies an area of 15 square miles, stretching long and narrow along the bank of the river, and being laid out in a fairly regular plan.

The most notable buildings are the commissioner's house, the law courts, and Government offices, the General Hospital, the Government schools, and St. Matthew's, St. Patrick's, and St. Augustine's Churches; the European residences, generally in spacious and well-kept grounds, are on the western side of a central ridge. In 1911 the population was 57,582.

The port, custom, and telegraph offices are on the bank of the river, which is bunded, and there are good landing piers.

Communication.—There is steam communication with Rangoon three times a week, the local steamers employed making the passage in 9 hours; with Calcutta, Madras, Colombo, Bombay, touching at all important ports, by British India Steam Navigation Co.'s steamers weekly, this line having a fortnightly service to Ye Tavoy River, Mergui, and Penang; also to Calcutta direct, and via Rangoon, by steamers of the Asiatic Steam Navigation Co. Coasting steamers connect with the southern provincial ports of Tavoy and Mergui fortnightly, and the inland waters are served by steamers of the Irrawaddy Flotilla Co. A weekly steam service is maintained to Penang and Singapore. Moulmein is connected with the universal telegraphic system, but it has no railway communication.

Coal and supplies.—About 800 tons of coal are kept in stock and about 5,000 tons imported annually; coaling is carried on by bags, and there is a large number of lighters holding from 13 to 180 tons. About 75 tons could be put on board in 24 hours; there is also a coal wharf 56 feet in length, with a depth of 6 feet alongside.

Supplies of fresh meat, vegetables, and bread may be obtained, and drinking water is brought in tank boats; the water is brought from a reservoir, situated 4 miles southward of the town.

Caution.—Deaths from cholera have occurred from drinking the river water; although quite fresh it should not be used.

Repairs.—Small repairs can be executed at Moulmein and copper-smith's work done; a traveling crane will lift 5 tons.

Hospital.—There is a good hospital at Moulmein, with accommodation for 50 European seamen and 9 officers.

Trade.—The chief exports are husked rice, teak, and rice bran, and the imports betel nuts, sugar, and provisions of various kinds. The principal native industries are gold and silver work and ivory

carving, and there are 14 steam sawmills, 3 rice mills, besides a steam joinery and a foundry.

Winds and weather.—In December the wind is chiefly from northeast to east, light, sometimes shifting to the north, and even northwest; the weather fine and clear.

In January the wind continues light from the same quarter, but in the early part of the month the mornings and evenings are misty, though the weather is fine; toward the end of January the wind veers southeastward, and the weather becomes foggy.

In February light land and sea breezes set in, the land breeze being from east and northeast, the sea breeze from west and northwest.

In March the land and sea breezes continue, the land breeze being from southeastward and the sea breeze from southwestward, the former light, but the latter sets in with strength, and blows fresh at Amherst between 2 p. m. and 4 p. m., after which it dies away.

From July to September the weather is very stormy.

Fogs.—The weather is fine in February and March, but fogs become frequent and thick toward the end of the former and throughout the latter month. They are thick, and last for three or four days at a time, obscuring even the banks of the river, and rendering its navigation difficult; this being further increased by the natives lighting large fires to burn the paddy husk and straw, causing dense smoke and adding to the thickness of the weather.

Amherst District.—From Amherst the coast line of Amherst District extends in a south-southeast direction for about 55 miles to the entrance to Ye River.

Coast.—From Amherst Point the coast, trending in a southerly direction for $4\frac{1}{2}$ miles to abreast of Button Island, then turns southeastward for 4 miles to abreast of Krapo Island and is rocky, indented, and has occasional cliffs; Tsheng Taung, 934 feet high, a very conspicuous hill $2\frac{1}{2}$ miles east-northeast of Button Island, has been already mentioned.

From Krapo Island, where there is a pagoda 70 feet high, the coast has a southeast direction for $5\frac{1}{2}$ miles, and then turns to the southward for about 8 miles to Bluff Point, forming a bight; a point, surmounted by a hill 310 feet high, projecting from the coast at $3\frac{1}{2}$ miles from Krapo Island is conspicuous, but the rest of the coast is low and densely covered with jungle to the water's edge.

Sand flats, covered with mud near the beach, uncover for a distance of $1\frac{1}{2}$ miles from the shore near the center of the bight, and there are entrances to several creeks; at $1\frac{1}{2}$ miles northward of Bluff Point is a pagoda, situated on a small reef connected to the shore.

In the bight between Krapo Island and Bluff Point mud flats extend about $1\frac{1}{2}$ miles from the coast for a distance of 7 miles north-

ward of the latter, and the 5-fathom contour crosses the bight at a distance of about 3 miles from the coast off the center of the bight.

Double Island, $12\frac{1}{2}$ miles southward of Amherst Point and nearly 5 miles offshore, has trees on it which rise to the same height as the top of the lighthouse; it is steep-to on its western side, but rocky ledges, with depths of from $2\frac{1}{2}$ to $4\frac{1}{2}$ fathoms over them, extend for a distance of $\frac{1}{2}$ mile south-southeastward and 300 yards eastward and also northward of the island. The channel between the island and the mainland is clear of danger.

Light.—On the north point of Double Island, from a masonry tower, 75 feet high, painted white, is exhibited at an elevation of 120 feet above high water, an occulting white light, visible 17 miles. (For details see Light List.)

Landing on Double Island is difficult in bad weather; the landing place is close to a crane on the eastern side of the island.

Caution.—Shoaler water than charted having been reported to exist off Double Island, this locality should be navigated with care.

Tides.—It is high water, full and change, at Double Island at 2h. 5m.; spring rise $18\frac{1}{2}$ feet, neaps 12 feet; neaps range $7\frac{1}{2}$ feet.

Tidal streams.—The tidal streams in the vicinity are strong, running $4\frac{1}{2}$ knots at springs and about 2 knots at neaps, the flood setting northward and the ebb southward. The streams turn about half an hour after high and low water at Amherst Point; there is very little slack water.

North Rocks are two detached groups 1.3 miles apart in a north and south direction. The northern group covers at high-water spring tides, and the highest of the southern group is 20 feet high, and situated nearly $7\frac{1}{4}$ miles south-southeastward of Double Island.

Patches of $4\frac{1}{2}$ and $4\frac{3}{4}$ fathoms lie between the northern group and the 5-fathoms contour of the coast, and vessels should not pass between North Rocks and the mainland.

Coast.—From Bluff Point to Pagoda Point the coast, trending for a distance of $8\frac{1}{2}$ miles in a southerly direction, has thick jungle growing to the water's edge, and between these two points are the entrances to Hteng-yu and Anin Creeks, which dry at low water; the coast is generally sandy, with a few rocky points fronted by mud and sand flats, with occasional rocky patches.

Evans Ridge, a low range of coast hills, from 300 to 420 feet high, commences about $3\frac{1}{2}$ miles south-southeastward of Bluff Point, and from that curves to the southeastward for 2 miles.

From Pagoda Point the coast trends south-southeastward for $5\frac{1}{2}$ miles, and then turns south-southwestward for 3 miles to Bentinck Point, off which reefs extend for $1\frac{1}{4}$ miles in a northwest direction; Thebeye and Thanze (Dermonjai) Creeks enter the sound in this

stretch of coast, which latter is covered with jungle, except for two conspicuous coast hills.

Keokpadang Pagoda, $4\frac{3}{4}$ miles southward of Pagoda Point, and off the entrance to Thanze Creek, stands on a reef, $\frac{1}{2}$ mile in length in a north-northeast and opposite direction, and 600 yards in breadth, which is connected to the shore by a sand flat, drying a low water, spring tides.

Kulagauk Island.—**Portland Point**, the north point of Kulagauk Island is 17 miles southward of Double Island; Kulagauk Island affords a good landfall during the southwest monsoon for vessels bound to Moulmein. The island is $5\frac{1}{2}$ miles in length in a north and south direction, or parallel with the coast, and nearly 1 mile in greatest width, and is formed of several hummocks, Woodstock Hill, the summit and northernmost, being 600 feet high.

The coasts are much indented and formed chiefly by cliffs, with some small sandy bays and mangrove swamps between them, and the shores are steep to all round, the 5-fathoms contour being nowhere more than $\frac{1}{2}$ mile off.

About $\frac{1}{2}$ mile southward of the southern point is Cavendish Islet, 320 feet high, with rocks extending from its northeast and southwest sides, the former awash at high water, spring tides, and the latter drying 11 feet; shoal water extends 800 yards southward of the islet.

The Peepers, two small rocks, 2 feet high, are 400 yards off the west coast of Kulagauk Island, nearly 1 mile north-northwest of its south point.

Galloper Sand, extending in a northerly direction for $6\frac{1}{2}$ miles from Portland Point, the north extreme of Kulagauk Island, is about 1 mile in width at its southern part, tapering to its extreme, and dries in patches at low water.

Kropik (Tree) Island, about 400 yards in extent and 180 feet high, is situated about $\frac{3}{4}$ mile off the mainland, and nearly 2 miles eastward of the north extreme of Galloper Sand. A shoal with a depth of $2\frac{1}{2}$ fathoms over it lies 1,200 yards westward of the north point of Kropik Island.

South Shoal, the north extreme of which is separated from the shoal extending from Cavendish Island by a channel 700 yards in breadth, with depths of from $6\frac{1}{2}$ to 8 fathoms, extends in a southerly direction for a distance of 2 miles, with a greatest breadth of $\frac{1}{2}$ mile, within the 5-fathom contour; it has a least depth of 4 fathoms over it.

Bentinck Sound, between Kulagauk Island and Galloper Sand on the western, and the mainland on the eastern, side, affords secure anchorage, especially during the southwest monsoon, in depths of

from 6 to 8 fathoms over a space 8 miles in length and $3\frac{1}{2}$ miles in width.

Entrances.—The northern entrance to Bentinck Sound, between the 5-fathom contour of the north extreme of Galloper Sand and that of the shoal water extending from the mainland northward of Kropik Island, is nearly 1 mile in width. The southern entrance between Cavendish Islet and Bentinck Point is $3\frac{1}{2}$ miles in width between the 5-fathom contours.

Depths.—The depths in both entrances are from $6\frac{1}{2}$ to 8 fathoms.

Anchorage.—The best berth is in from 6 to 7 fathoms water, about $\frac{1}{2}$ mile off Steep Point, a point about the middle of the eastern side of Kulagauk Island.

Middle Ground, with a least depth of $4\frac{1}{2}$ fathoms, over muddy bottom, is $1\frac{1}{2}$ miles in length in a north-northwest and opposite direction and about 400 yards in greatest breadth; its south extreme is nearly 2 miles westward of Pagoda Point.

Directions—Northern entrance.—The south extreme of Kropik Island in line with Symms Hill, 1,290 feet high, isolated, conspicuous, and situated 6 miles eastward of Pagoda Point, bearing 130° , leads midway between the north extreme of Galloper Sand and the shoal water extending from the coast northward of Kropik Island, and when the northern summit of Evans Range bears 80° steer 181° to pass between Galloper Sand and Middle Ground, taking care to avoid being set by flood stream toward the former or by the ebb toward the latter.

Without local knowledge this entrance should not be used by a vessel of deep draft, as no leading marks can be given after passing the northern end of Galloper Sand, and the tidal streams set very strongly and obliquely across the channel.

Southern entrance.—Entering from the southward, Sharp Hill should not be brought to bear southward of 85° until the east side of Kulagauk Island is open of the eastern extreme of Cavendish Islet, bearing 5° , when alter course to pass 1 mile eastward of that island.

Tides.—It is high water, full and change, in Bentinck Sound at Oh. 31m.; springs rise $18\frac{1}{2}$ feet; neaps rise 12 feet.

Tidal streams.—The tidal streams run through the channel, forming the northern entrance, with a velocity of 5 knots; both flood and ebb set toward Galloper Sand, the former when inside and the latter when outside, or westward of it.

The rates of the tidal streams in Bentinck Sound are from 2 to 3 knots.

Water.—A small quantity of water may be obtained from a spring close to Pulpit Rock, on Kulagauk Island.

Coast.—From Bentinck Point the coast trends in a south-southeast direction, for a distance of $5\frac{1}{2}$ miles, and then southwest for about the

same distance, curving around Hope Point, which is rocky and surmounted by a small hill 360 feet high; sand and mud flats front the shore, drying out to a distance of $1\frac{1}{4}$ miles. From Hope Point the coast has a southerly direction, is cliffy, much indented, and with densely wooded hills close behind it; of these Phalein Hill, 1,710 feet high, and situated 4 miles south-southeastward of Hope Point, is very conspicuous.

Aye Island, $1\frac{1}{4}$ miles offshore, 3 miles south-southwestward of Hope Point, is 1,600 yards long in a northwest and southeast direction, 600 yards broad, and 460 feet high: it is densely wooded, and has rocky shores, difficult to approach.

A shoal, of which a considerable part dries at low water, spring tides, extends first in a northerly direction from Aye Island, and then curves to the north-northeastward, its northern extreme being about $\frac{1}{2}$ mile northwestward of Hope Point; shoal water also extends about 1,200 yards southward of the island.

Ye River—Approach.—The high land, of which Phalein Hill is the summit, extends to the southwestward to $4\frac{1}{2}$ miles northward of the mouth of Ye River, and the steep and rocky coast, thickly wooded, after a small creek is passed, changes to a sandy beach, fringed with jungle, which extends for $3\frac{1}{2}$ miles to Pagoda Point.

Pagoda Point, a conspicuous hillock 151 feet high, rising abruptly from the beach and surmounted by a small pagoda, forms the northern, and Sidawtaung, a bold headland 577 feet high, which from the westward and northwestward appears flat-topped but from southward conical, the southern entrance point to Ye River.

The coast southward of Sidawtaung for a distance of 9 miles is low and sandy with occasional small headlands, but the high ranges at the back give it the appearance of being steep.

Toby Rock, about 2 miles south-southeastward of Aye Island and 1,200 yards offshore, nearly covers at high water and is situated on a ridge with depths of $3\frac{1}{2}$ fathoms over and from 6 to 7 fathoms around it.

Stag Island (Wa Gyun), the northern of the islands lying off the mouth of the river, is 1 mile long in a north and south direction and has two summits, the northern and higher being 444 feet high. Its western side is steep, but on its eastern side there is a beach where fresh water can be obtained.

A spit, with depths under 3 fathoms, extends 1,700 yards north-northwestward of the north end of the island, and a similar spit projects about $\frac{1}{2}$ mile in a southeast direction from the south end.

Outer (Nat Gyun) Island, the trees on which are 153 feet high, is about 1,800 yards southwestward of Stag Island and has rocks awash at high water, spring tides, lying 400 yards northward of

its north point, with shoal water to the 5-fathom contour, extending nearly 1 mile northward of them.

Bath Bun (Nya Pya Gyun) Island, 444 feet high and about $\frac{1}{2}$ mile southeastward of Outer Island, is 1,200 yards long in an east and west direction and is on the northern end of a ridge of hard sand, nearly $3\frac{1}{4}$ miles long in a north and south direction, which dries from 3 to 4 feet; a detached bank, which dries from 2 to 5 feet, lies northward of Bath Bun Island, and, with the shoal extending from Outer Island, forms the southwestern side of the channel separating these from Stag Island, which channel, although having depths of from 7 to 11 fathoms, is not recommended to be used.

Ghorparay Rock, 600 yards southwestward of the western extreme of Bath Bun Island, dries about 3 feet.

From the 3-fathom contour at the north end of these islands the narrow ridge extends, with depths under that, continuously for a distance of $12\frac{1}{2}$ miles in a southerly direction, and 1 mile westward of its northern part are depths of from 7 to 8 fathoms, even bottom, sand and mud, while farther south, at the same distance, they increase to 10 fathoms.

Kyetiki Gyun, a low wooded islet, the tops of the trees being 78 feet high, lies $1\frac{1}{4}$ miles southeastward of Bath Bun Island, and between Pascoe and Simpson Shoals.

Pig (Gyun Gyi) Island consists of four distinct wooded hills connected by low sandy beaches, the southern and largest hill being 534 feet high, and steep on its eastern side. Shallow sands, on which the sea incessantly breaks, extend nearly $1\frac{1}{2}$ miles westward of the island, and the southern extreme of the ridge, above mentioned, is $4\frac{1}{4}$ miles southward of it. There is a deep water immediately eastward of Pig Island and across to the mainland forming a good channel and secure anchorage.

Tamarind (Maji Gyun) Island, 4 miles south-southeastward of Pig Island and $1\frac{1}{2}$ miles offshore, is small, triangular shaped, and 260 feet high. The deep channel passes close westward of it.

Hoare Island, $3\frac{1}{2}$ miles farther south-southeastward, is similar, but lower.

Livermore Shoal is a ridge of sand $2\frac{1}{2}$ miles long in a north and south direction on which there are two patches with depths of 2 and 3 fathoms, respectively, the shoaler spot being $3\frac{1}{2}$ miles westward of the summit of Stag Island; the 10-fathom contour passes close westward of the shoal. Pagoda Point just open northward of the northern end of Stag Island bearing 117° leads northward of this shoal, and the lead is the best guide for passing seaward of it, the water not being shoaled to less than 12 fathoms in its vicinity.

Headlam Patch, of small extent, with a least depth of $6\frac{1}{2}$ fathoms over it, is situated $5\frac{1}{2}$ miles west-southwestward from the western end of Bath Bun Island.

Shearme Sand, the northern end of which is 8 miles westward of the north point of Pig Island, extends in a north and south direction for a distance of $5\frac{1}{2}$ miles, is $\frac{1}{2}$ mile broad, and has depths of from 6 to 10 fathoms over it.

Sinclair Shoal extends nearly 5 miles in a north and south direction, is about $1\frac{1}{2}$ miles in greatest breadth, and has depths of from 5 to 10 fathoms over it; its north end is 23 miles west-southwestward of the south point of Pig Island. Detached shoals, with depths of 9 and 10 fathoms over them, lie southward and southwestward of Sinclair Shoal.

Ross Sand, the northern end of which lies about 2 miles westward of the southern end of the shoal extending southward from Pig Island and $6\frac{1}{2}$ miles from the land, is 7 miles in length in a north and south direction, and barely 1 mile in breadth anywhere, is steepest on its eastern side, and is generally discernible by discoloration and tide rips.

The general depths on the shoal are from $3\frac{1}{2}$ to 5 fathoms, but near its northern part is a patch about $1\frac{1}{2}$ miles in length, with from $1\frac{1}{2}$ to 3 fathoms over it, and there is a patch of 3 fathoms near the southern end. No directions can be given for clearing the sand, and the lead is of little use; bearings of Pig Island, Moskos Islands, and North and South Peaks will fix the position.

It will be noticed that a chain of islands and ridges extends southward parallel to the coast for about 21 miles from Livermore Shoal and Stag Island, with no passages that can be recommended between them.

Pascoe Shoal, lying about 1 mile off the bar of Ye River, is a narrow shoal of sand $1\frac{1}{2}$ miles long in a north-and-south direction within the 3-fathoms contour; the center of the shoal has a depth of about 1 foot over it at low water, spring tides, when there is a depth of not less than 4 fathoms in the channel, and its northern end lies 1.1 miles southwestward of Pagoda Point, the south extreme being a little southeastward of Kyetiki Gyun.

The channel eastward of the shoal is the safer, and a useful leading mark, the eastern extreme of Aye Island in line with the western extreme of the mainland, bearing 339° , leads through it.

Simpson Shoal, trending south for $2\frac{1}{2}$ miles from Kyetiki Gyun, is similar in shape to Pascoe Shoal, and has a least depth of 1 fathom, over sand and mud, near its center. A channel $\frac{1}{2}$ mile wide, between this shoal and the long ridge extending southward from Bath Bun Island, can be used by keeping Bath Bun and Stag Island just

touching, bearing 352° ; but the channel eastward of Pascoe Shoal is to be preferred.

Clearing mark.—Kyetiki Gyun open westward of the high land over the coast to the northward, bearing 351° , leads eastward of Simpson Shoal.

Anchorage.—There is good anchorage for large vessels eastward of Stag Island, with its northern extreme bearing 299° and its southern extreme 215° ; and eastward of Pascoe Shoal, on the leading mark, the eastern extreme of Aye Island in line with the western extreme of the mainland, bearing 339° , and Kyetiki Gyun 212° . There is also good anchorage eastward of Pig Island.

Directions.—From the northward Kulagauk Island, and then Aye Island under the high land, and Stag Island farther out, should be sighted, and the latter approached bearing 147° , which leads $1\frac{1}{2}$ miles southwestward of Aye Island, and on making Pagoda Point, which appears as a hummock at the end of a level stretch of beach, bring it in line with the western slope of Sidawtaung and a dip in the distant high land, bearing 129° .

Keep this mark on, which leads about 300 yards northeastward of the shoal extending off the northern end of Stag Island, and when the eastern extreme of Aye Island is in line with the western extreme of the mainland bearing 339° , steer 159° , using it as a stern mark to lead to the anchorage eastward of Pascoe Shoal.

To anchor eastward of Stag Island approach as above, and when the eastern end of Bath Bun Island opens eastward of Stag Island, bearing 189° , steer about 165° for the anchorage.

From the southward, pass inside Ross Sand, which is generally marked by discoloration and tide ripples, with Pig Island bearing 1° until Tamarind Island bears 46° . Then steer for midway between Pig Island and the mainland until Pagoda Point is in line with a notched peak a short distance behind it, bearing 4° . This mark leads eastward of Simpson Shoal and to a position off the bar eastward of Pascoe Shoal.

Tides.—It is high water, full and change, at Stag Island at 0h. 13m.; springs rise 18 feet, neaps rise 12 feet; neaps range 3 feet. The lowest tides are in February and March. Inside the bar high water is 5 minutes later than outside, but the times of low water differ considerably, the escape of water at the bar being checked by the sands, so that the tide outside commences to rise some time before that inside. Owing to this check the level of the water inside the bar at springs never falls so low as that outside.

When allowing for the rise of tide above the soundings on the chart it must be borne in mind that there is 3 feet less rise on the bar than there is outside. Owing to this, although neaps rise $12\frac{1}{2}$ feet at Stag Island, they only rise 9 feet on the bar, with minimum

range only $7\frac{1}{2}$ feet. As the bar nearly dries, this limits the entrance, at ordinary high-water neaps, to vessels of less than 7 feet draft.

Tidal streams.—The flood tidal stream sets northward along the coast at a rate of about 3 knots at springs. The ebb sets southward at the same rate. At springs the water is much discolored outside the islands.

Ye River, which enters the sea between Pagoda Point and Sidawtaung, is said to have its source beyond the British frontier in Siam, and after passing through the hills eastward of Ye District flows through cultivated land past Ye Town, whence it follows a very tortuous course to the sea, and at about half way divides into two branches, which join again near the mouth and form Chauma Gyun, a large island between them.

Depths.—The bar nearly dries at low water, and although the rise of tide is 15 feet at springs and 9 feet at neaps, the greatest depths to be expected with minimum range are 12 feet and $7\frac{1}{2}$ feet, respectively; it must be remembered that there is always 3 feet less rise of tide on the bar than outside.

The river is only navigable for short vessels drawing less than 7 feet at neaps; but vessels drawing 13 feet might reach the town at springs.

Beacons.—The outer beacon or western mark for crossing the bar is a diamond, painted white, surmounting a pole near the fishing stakes 1,200 yards northeastward of Sidaw Point.

South Inner Beacon, or eastern mark, is a globe, painted white, in a tree at the edge of the mangrove northeastward of Sidaw Point.

North Inner Beacon, for use in crossing the inner part of the bar, is a triangle and diamond, painted red, in a tree a little distance northward of South Inner Beacon.

Immediately northward of the eastern entrance point, which is the bluff west extreme of Sidawtaung Hill, are two white balls, one on a pole on an outlying rock off the bluff, and the other on a tree on the east end of the same bluff.

At the mouth of Oagi Chaung Creek is a globe, painted white, in a tree, used for clearing the sands when across the bar and heading up the river.

To cross the bar.—It is necessary to cross the bar at high water, both for increased depth on the bar and so as not to carry a strong flood stream up the river, with which a vessel could not steer round its sudden bends and the numerous sands, which are difficult to clear.

At high water neaps not more than $7\frac{1}{2}$ feet of water can be depended on, but within a day or two of spring tides there is always a depth of 12 feet at high water in the channel.

With the west extreme of the bluff under Sidawtaung bearing 57° , the eastern and western marks are a little to the left of it, and the

outer beacon (diamond, white, surmounting a pole) in line with the South Inner Beacon (globe, white, in a tree), bearing 51° , lead across the outer part of the bar, until Pagoda Point bears 323° , with the bend of the beach 1 mile northwest of it just shut in, when the two globes (one on a pole, the other on a tree) immediately northward of the western extreme of Sidawtaung will come in line, bearing 71° , and should be steered for until the outer beacon (diamond, white, surmounting a pole) is in line with the North Inner Beacon (red, triangle, and diamond, in the trees northward of the eastern mark) 49° .

Steer with this last mark on until the extreme of the bluff bears south, when keep a little northward, bringing the western mark between North and South Inner Beacons. This leads in until the next reach of the river opens to the northward. Then keep Asun Pagoda, a conspicuous object on the west bank of Asun Chaung, well open clear of Zibuthang Point, which is the inner extreme of the entrance on the north side, bearing 351° , and pass Zibuthang Point 100 yards distant. Oagi Chaung Beacon (globe, white, in a tree) in line with Asun Hill, bearing 345° , also leads up this reach.

The river here divides into two branches, that to the northward past the pagoda being quite shallow when examined in 1887; Zibuthang Reach, the other, trending eastward and northeastward, leads, by somewhat intricate navigation, to the town of Ye.

Tides.—Inside the bar of the river it is high water, full and change at 12h. 18m.; springs rise 15 feet, neaps rise 9 feet; neaps range 2 feet.

At Ye Town it is high water, full and change, at 1h. 8m. approximate; springs rise $13\frac{1}{4}$ feet, neaps rise $6\frac{1}{2}$ feet.

Tidal streams.—Over the bar and inside the river the first of the flood stream sets in the line of the channels, but when the sands are covered, and at neaps, when they do not uncover, it sets for Zibuthang Point. The ebb sets similarly in a contrary direction and tends to set a vessel coming down the last reach on to the sands southward of Zibuthang Point. It is very strong in the channels after the sands are uncovered and runs at a rate of 4 knots off Sidaw Point.

In the upper reaches the streams follow the direction of the channels, eddies being met with under the lee of the bends. At Ye the flood runs for about 5 hours.

Ye, situated nearly 7 miles northeastward of the bar in a direct line, is the capital of Ye District, which lies between Amherst and Tavoy, in the Province of Tenasserim. The range of hills on the southern side of the river entrance forms the boundary between Ye and Tavoy Districts.

The town stands on high ground on the north bank of a bend of the river, and its pagodas are conspicuous for many miles. Its population was 3,500 in 1901.

Communication.—The British India Steam Navigation Co. has a fortnightly service of steamers to Moulmein, Tavoy, Mergui, and Penang, and there is telegraphic and postal communication.

Supplies.—Rice, fish, and vegetables are easily obtainable; also wood, which is the fuel used by the trading steamer.

Piers.—There are two piers built of wood, but the foundations of the older one having sunk, it is almost useless.

Trade consists chiefly in the import of tobacco, cotton and silk piece goods, earthenware, and porcelain; and exports of paddy, salt, dunnies, sessamum, and boats.

Climate.—Fine weather prevails from the middle of November to the middle of March. Northerly and easterly winds prevail during the day, and westerly breezes in the afternoon, during February and March.

During February the weather is frequently hazy. The rainy season does not end till November 15, and up to that date fever is prevalent. The temperature near the mouth of the river ranges from 80° to 90° at midday between November and March, and 60° to 70° in the early morning.

Tavoy District, commencing at the south entrance point to Ye River, has a coast line of nearly 130 miles in length, and includes Heanzay Basin and Tavoy River.

Coast.—Between 8 and 9 miles southward of Sidawtaung the high land closes the coast, and the headlands become larger until White Point is reached, which is 17 miles southward of the entrance to Ye River. North Peak, 2,540 feet, and Krunangi or South Peak, 2,590 feet high, are 1½ miles apart, about 7 miles northeastward of White Point, but as there are other peaks of nearly the same height in their vicinity they are not easily distinguishable.

The coast from White Point is bold, rocky, and trends south-southeastward 11 miles to Dolphins Nose, the northern entrance point to Heanzay Basin.

The coast for 10 miles southward of Dolphins Nose should not be approached within 7 miles; eastward of north Moskos Island it can be approached nearer.

Anchorage.—Dolphins Nose may be steered for bearing between 80° and 102°, and anchorage obtained in a depth of 4½ fathoms, about 1½ miles off the land.

Heanzay (Hinze) Basin, formed by three large creeks which unite and flow into the sea through a funnel-shaped estuary, between hills 1,480 feet high on the north and 810 feet high on the

south side, is $2\frac{1}{2}$ miles in length, in a northeast and southwest direction.

The shores of the three large creeks, which form the basin, are, with the exception of a few rocky points, fringed in all parts by mangroves, and are intersected by numerous smaller creeks; the whole district is sparsely populated.

These creeks are navigable by small craft for short distances.

Dolphins Nose, the northern entrance point, is the abrupt termination of a hill 1,000 feet high, and $\frac{1}{2}$ mile east-southeastward of the point is Position Rock, which is awash at high-water spring tides.

Kantaung Promontory, the southern entrance point, is formed by an isolated hill 420 feet high.

Dangers.—North Sands extend for a distance of $4\frac{1}{2}$ miles in a south-southwest direction from the coast immediately westward of Dolphins Nose, and are about $2\frac{1}{2}$ miles in width, with depths under 12 feet, drying in patches at low-water spring tides.

South Sands extend for fully 3 miles in a south-southwest direction from the south point of Kantaung Promontory, and are about $\frac{3}{4}$ mile in greatest breadth, with patches drying at low-water spring tides, for a distance of $2\frac{1}{2}$ miles from the promontory.

Entrance.—The entrance between North and South Sands is obstructed by a bar, the outer part of which is fairly level; inside between the sands are a number of shoal patches with, in places, comparatively deep water between them.

Depths.—The outer part of the bar has a general depth of 14 feet, and the entrance is easy of access at springs to vessels drawing 15 feet, or at neaps to those of 10 feet; if properly buoyed, vessels of 25 feet draft might enter at springs, and 19 feet at neaps.

Anchorage may be obtained anywhere after passing Kantaung Promontory, but the depths are more convenient, and the tidal streams slacker, on the southern side.

There is good anchorage within the basin in a depth of 7 fathoms, over mud, midway between Fish Trap Point and the south end of Kwethongyima Promontory.

Directions.—As the deepest drafts that should enter at springs and at neaps are 15 and 10 feet, respectively, no larger vessel should attempt to cross the bar without having previously buoyed the channel.

Vessels of light draft should steer for the northern part of Kantaung Promontory, when bearing 46° , making due allowance for the tidal streams, which set across the bar, and when about $\frac{3}{4}$ mile from the promontory shape a course to pass it at a distance of from $\frac{1}{2}$ to $\frac{1}{4}$ mile.

If proceeding into the basin, mid-channel should be kept until abreast East Point, when steer more toward the southern side of the

channel to avoid the spit extending from Kwethongyima Promontory.

Tides.—It is high water, full and change, at Kantaung Promontory at 11h. 44m.; springs rise $14\frac{1}{2}$ feet, neaps $9\frac{1}{2}$ feet, and neaps range $3\frac{1}{2}$ feet.

Within the basin the time of high water is from 20 to 30 minutes later, and of low water from the same time to 15 minutes later, than that at Kantaung Promontory, while the range of tide, both at springs and neaps, is about 1 foot more.

Tidal streams.—In the offing the flood stream sets to the northward and the ebb to the southward, commencing to run at from two to three hours after the times of high and low water at Kantaung Promontory, and attaining a velocity of from $\frac{1}{2}$ knot to $1\frac{1}{2}$ knots.

Outside South Sands the tidal streams set across the bar and along the eastern edge of the sands, their direction being parallel to the channel until the sands are covered, when they set slightly across them with an estimated velocity of from $1\frac{1}{2}$ to 3 knots.

In the entrance to the basin the ebb stream makes at from a quarter to three-quarters of an hour after high water, and runs with a velocity of from 1 knot to 3 knots; the flood stream makes at from half an hour to one hour after low water, and flows with rates of from $\frac{1}{2}$ knot to $1\frac{1}{2}$ knots.

Within the basin the ebb stream makes at about half an hour after high water and the flood stream almost immediately after low water at Kantaung Promontory.

NOTE.—The tidal observations, on which these remarks depend, were made during the dry season. During the rainy season the ebb will be considerably stronger than the flood, and, at its height, may possibly overcome it altogether.

Coast.—From Kantaung Promontory the coast trends in a south-southeast direction for about 24 miles to Fenton Point, near which there is a pagoda, not conspicuous from seaward.

Fenton Point marks the end of the range of hills near the coast, and is the northern extremity of Maungmagan Bay.

Tapir Hill, situated about 6 miles south of Kantaung Promontory, is 1,212 feet high, and nearly 1 mile from the coast; Middle Hill, 1,683 feet high, is situated east-southeast $2\frac{1}{2}$ miles from Tapir Hill, and from it a range extends parallel with the coast for about 7 miles. A high range of hills inland extends in a north and south direction with one remarkable summit, known as Allen Peak, 2,970 feet high, in the center. Nabule Punkhun, 3,830 feet high, marking the southern end of this range, appears blunt when seen from the westward, but from the southward appears as a peak.

Tapir Hill, Middle Hill, Luce Hill, Sieve Hill, and Allen Peak are all densely wooded.

Creek.—About 16 miles south of Kantaung Promontory is the entrance to a creek which communicates with Heanzay Basin; it extends between Middle Hill and Nabule Punkhun Range.

Moskos Islands, consisting of three groups, Northern, Middle, and Southern; which are known to the Burmese as Heanzay, Maungmagan, and Laung Lun, extend in a chain parallel to the coast for a distance of 41 miles from North Islet, which is situated 11 miles southwest of Tapir Hill. Around these islands is an extensive unworked area of pearling ground.

The channel between the islands and the mainland is generally from 8 to 10 miles in width, with depths of from 11 to 18 fathoms, but between North Ledge and the shoal extending northward of North Island it is reduced to $2\frac{1}{2}$ miles; abreast the Northern and Middle Groups the 10-fathom contour line is from 3 to 6 miles off the coast, and the area within it is only partially sounded.

The coast bank of soundings appears to extend a great distance westward of the Moskos, there being depths of 50 fathoms at a distance of 65 miles in that direction.

Northern Moskos, almost united to Middle Moskos by scattered islands and rocks, are straggling islands of various sizes, with several rocks above water. Long Island (Hinze Bak), 1,025 feet high and near the northern end of this group, is the largest, and Quoin Island, the southernmost of this group, is 1,177 feet high.

North Islet, the northermost of the group, is 450 feet high, and has rocks 28 feet high situated $\frac{1}{2}$ mile north-northeastward of it.

North Patch.—This isolated rocky patch, covering at high water, is situated 2 miles north of North Islet.

North Ledge, an isolated rock, 3 feet high, with shoal water extending from it $\frac{1}{2}$ mile in a northeasterly direction, is situated $4\frac{1}{2}$ miles northeastward of North Island.

A shoal of $3\frac{1}{4}$ fathoms is situated close northeastward of North Ledge.

There is a good channel between North Patch and North Ledge, with a depth of 11 to 14 fathoms.

Middle and Southern Moskos are the largest and highest of the Moskos Islands, the southernmost island being 1,186 feet high.

South Islet.—This small rocky islet, covered with jungle, is situated $\frac{3}{4}$ mile southeastward of South Moskos Island, and South Ledge, a rocky patch awash at high water, is situated $\frac{3}{4}$ mile southward of the same island. There is a narrow passage between these and South Moskos Island, which should not be used by shipping.

Maungmagan Passage, between Middle and South Moskos Groups, is about 12 miles wide, clear of all dangers, and with a depth of 13 to 23 fathoms.

Moskos Islands are steep on their western sides.

Vessels proceeding inside Moskos Islands by day pass eastward of North Ledge, when approach to Heanzay Banks is indicated by the lead.

Anchorage.—There is good anchorage in bad weather in a depth of 9 or 12 fathoms eastward of Middle Moskos Island, between that island and Cradle Rocks, also northward of Middle Moskos Island eastward of Neat's Tongue Island.

Anchorage in a depth of 12 to 14 fathoms can also be obtained eastward of North Island, with North Button Island bearing 350° west.

Coast.—From Pagoda Point, the south entrance point of Maungmagan Bay, the coast trends southward for 16 miles to Oyster Island, 477 feet high, which is not conspicuous when seen from seaward, appearing as part of the mainland.

Five small islands are situated near this coast.

From Oyster Island the coast is bold and rocky, being indented by small bays, and extending in a southerly direction for $8\frac{1}{2}$ miles to Nyan-byni Bay.

Nyan-byni Bay.—This bay is 3 miles wide at the entrance and recedes about 2 miles, gradually shoaling from a depth of 10 fathoms as the shore is approached.

A large fishing village is situated on the southern side, from which a road across the promontory leads toward Tavoy River.

Coast.—From Nyan-byni Bay the coast, which is bold and rocky, with no off-lying dangers, extends southward to the entrance of Tavoy River.

Aspect.—A mountainous ridge extends north and south at a short distance inland; Lakiataung, one of its summits, 1,966 feet high, 11 miles southward of Taungbataung, is marked by a pagoda.

CHAPTER VIII.

COASTS OF TENASSERIM AND SIAM—TAVOY RIVER TO SALANG ISLAND, INCLUDING THE MERGUI ARCHIPELAGO AND BROTHERS ISLANDS.

Tavoy River, having its main sources near the northern boundary of Tavoy District, in the western slopes of the range separating Burma and Siam, is about 120 miles in length, and has a depth of 12 feet throughout the year from Reef Island to Tavoy, a distance of 47 miles, and of 5 feet from Tavoy to Yebyu, a further distance of 16 miles.

The river enters a broad plain about 3 miles above Tavoy, and its course is impeded by sand banks and alluvial islands, constantly changing in form and position, which obstruct the river until the estuary is reached.

Many tidal creeks intersect the plain between the banks and the base of the hills on both sides of the river, and the Labachaung, the Pyinbugyichaung, and the Mindatchaung, three small rivers, the entrances to the two latter blocked by an extensive mud flat, flow into the northeast side of the estuary.

At the mouth of the Tavoy River are extensive unworked areas of pearling ground.

Aspect.—The hills run in parallel ranges generally north and south; rising at Tavoy Point (Shin maw) directly to a height of 1,120 feet, they gradually recede from the western side of the river, and at Goodridge Plains are $1\frac{1}{2}$ miles off, and nearly 2,000 feet high; they close the bank again abreast Tavoy.

On the eastern side of the estuary are low hills, with parallel ridges behind them gradually ascending to about 4,000 feet at the Nyataung Range, of which Buktaung, a summit 2,195 feet high, is abrupt and conspicuous, rising from a small range near the coast.

Thejaungtaung, 2,010 feet high and similar in appearance, is also conspicuous; it is situated $9\frac{1}{2}$ miles northward of Buktaung, and is a good mark to steer for after rounding Tavoy Point, and before shaping course up the river.

Northward of Elbow Point (Thamokmo), the hills close the left bank, and at Tsinbyubyin are $1\frac{1}{2}$ miles off, maintaining about that distance to Tavoy, where they recede, and rise in successive ranges to Nwa-la-bo Range, with its conspicuous peak, 5,063 feet high, which is 14 miles eastward of the town.

Cap Islet (Hnet thaik taung), nearly circular, about 600 yards in diameter, and situated off the western entrance point, is 523 feet high, and steep-to except on its eastern side, whence a shoal spit with depths of from 17 to 28 feet extends eastward about 600 yards. The channel between Cap Islet and the main is clear, with depths of about $8\frac{1}{2}$ to 17 fathoms, and may be used by steamers; but the tidal streams in it have a velocity of 3 knots at springs.

Tavoy Point (Shin maw), the western entrance point to the river, marked by a pagoda, is the southeastern extreme of a small peninsula, which is 1,120 feet high, and steep-to.

Byikhwaaw, the bay between the point northward of Cap Islet and Tavoy Point is about $1\frac{1}{4}$ miles in width, with depths of from 24 to 30 feet, but is shoal for $\frac{1}{2}$ mile from its head.

Kiantaung, 1,280 feet high and $3\frac{1}{2}$ miles northwestward of Tavoy Point, is covered with forest, but shows a light clearing from eastward and westward.

Puklaji, 1,400 yards north-northeastward of the northeastern extreme of Tavoy Peninsula, is a patch with a rocky head showing at low water, spring tides.

Reef Island or Gogaligyun, about 3 miles north-northeastward of the northern side of Tavoy Peninsula, is 1 mile long in a north and south direction, 600 yards wide, and 470 feet high; clearings of the trees, which have been made in places for the passage of the light rays, are conspicuous.

Light.—A square masonry tower, 31 feet in height, painted white, with a white dome, is situated on a hill near the northeastern point of Reef Island, from which is exhibited, at an elevation of 309 feet above high water, an occulting white light, visible 12 miles. (For details see Light List.)

Dangers.—A shoal on which the depths are from 6 to 15 feet extends $\frac{1}{2}$ mile in a south-southwest direction from the south extreme of Reef Island.

Nearly 400 yards southeastward of the southeast extreme of the island is the northern extreme of a shoal of sand, with depths of from 4 to 18 feet, which extends, with a width of about 600 yards, for a distance of 1.2 miles in a south-southwest direction, the least water being in its center.

Whale Rock (Gogalichaukpon), a reef of bowlders lying 400 yards eastward of the southeast end of Reef Island and 800 yards south-southeastward of the lighthouse, is just covered at high water, spring tides, and should not be approached within 200 yards.

Clearing mark.—The northeast extreme of Grindstone Island, just open eastward of Reef Island, bearing 347° , leads eastward of the above dangers.

Landing.—Boats can land on the beach about 400 yards southward of the lighthouse, to which there is a good road.

Water may be procured from a well near the landing place.

Middle Island or Thombongyun, $\frac{1}{2}$ mile northwestward of Reef Island, is 2.3 miles long in a north and south direction, 1,800 yards wide, 725 feet high, and thickly wooded. It is inhabited only during the fishing season, from January till April.

The bay between Middle Island and Tavoy Point is full of shoals and drying banks.

Button Islet or Satlugyun, about 200 yards off the middle point on the eastern side of Middle Island, is of granite and covered with trees, the tops of which are 162 feet high.

A shoal ridge, on the middle of which is Oyster Rock, 3 feet above water, extends south-southwestward for nearly 3 miles from Button Islet, passing between Reef and Middle Islands.

Grindstone Island or Kathemawgyun, situated 800 yards northward of Middle Island, is about $\frac{3}{4}$ mile long, $\frac{1}{2}$ mile wide, 550 feet high, and densely wooded; between the northern side of the island and a point about 1 mile to the northward is a bight filled with a flat that dries, and at the northeast point of the island is a large granite boulder, with a pagoda on it.

Mahratta or Yabaichauk Rock, 2 miles northward of the northeastern point of Grindstone Island, and nearly 1,400 yards off the west bank of the river, is a pinnacle, with a depth of 7 feet over it at low water, spring tides, and from 19 to 26 feet around it; it is marked by a strong ripple.

Rocky ground, with a depth of 18 feet on it, lies 800 yards eastward of Mahratta Rock, and the bottom in the locality is generally irregular and hard.

Chaukdaw Rock, 4.2 miles northward of Mahratta Rock and 400 yards from the west bank of the river, has 12 feet over it at low water, spring tides.

Leading marks.—From about 1 mile northward of the northeastern point of Grindstone Island, that point in line with the western side of Button Islet, bearing 173° , leads in the fairway eastward of Mahratta and Chaukdaw Rocks; and the conspicuous fall on the southern side of Tawantaung Hill, bearing southward of 249° , leads northward of Chaukdaw Rock.

Eastern shore.—The hills behind the eastern side of the estuary have been described, and the coast is flat, open land, with clumps of trees and paddy cultivation, and several small hills from about 250 to nearly 1,000 feet high dotted over it.

Nauwi Rocks, 4 feet high, are situated $5\frac{1}{4}$ miles southwestward of Buktaung Peak, and $2\frac{1}{2}$ miles offshore, and from immediately north-

ward of them the edge of a shoal, with depths of less than 18 feet over it, stretches in a northwest direction for about 5 miles, and then westward for about 3 miles, to a position about 7 miles southwestward of the eastern shore, and more than half-way across the estuary; from this position the edge trends northward nearly up the middle of the river.

Rocky, dangerous ground and sand and mud flats, which dry, extend from 1 mile to 2 miles off this side of the estuary, and off the entrance to the three small rivers already mentioned the mud flat extends about $2\frac{1}{2}$ miles off.

Elbow Point (Thamokmo), about $1\frac{1}{2}$ miles northward of the entrance to these rivers, is densely covered with mangroves, and from it the east bank of the river, consisting of paddy fields with clumps of trees, extends in a northerly direction for $7\frac{1}{2}$ miles to Tsinbyubyin.

Crab Island or Pinjigyun, thickly covered with trees and about 30 feet high, occupies the middle of the river for $6\frac{1}{2}$ miles in a north and south direction, its southern end being 2 miles northwestward of Elbow Point. On its east side, about $\frac{3}{4}$ mile and 2 miles southward, respectively, of the north point, are conspicuous trees, each 50 feet high.

From the southern end, a spit of sand and mud, dry in places, extends south-southeastward within depths of 12 feet for nearly $5\frac{1}{2}$ miles, and is prolonged in the same direction for 1 mile within depths of 18 feet, dividing the river into two channels. Near its extreme of 12 feet a large fish trap, placed in 10 feet at low water, existed a few years ago, but its existence must not be relied on.

New Island or Shityangyun, joined to the northern end of Crab Island at low water, spring tides, appears to be rapidly extending northward. A succession of similar low alluvial islands, connected by shoals, stretch up the river as far as Tavoy. Vessels of 12 feet draft can not proceed beyond New Island.

Entrance.—The entrance to the river, between the east side of Tavoy Peninsula, and the shoal which extends 7 miles off the eastern side of the estuary, is $4\frac{1}{2}$ miles in width, but between Reef Island, Whale Rock, and the shoal southward of it, on the west and the edge of the same shoal on the east side, it is reduced to 2 miles, and further reduced to about 1,600 yards between Grindstone Island and the shoal extending southward from Crab Island.

Depths.—From the entrance, where the depths are from 5 to 14 fathoms, and with the exception of a narrow bank, with 28 and 29 feet over it, which apparently connects the northeast side of Reef Island with the south extreme of the shoal extending southward of Crab Island, there are depths over 30 feet to nearly 1 mile above Grindstone Island, from this the channel westward of the shoal extending southward of Crab Island, has depths over 18 feet for about

3½ miles, and 12 feet for 4½ miles to the anchorage of Goodridge Plains; this latter depth being continued so far as Tavoy throughout the year.

In the channel eastward of Crab Island, leading to Tsinbyuyin Anchorage, a bar which extends from Elbow Point to the south side of Crab Island has a depth of 6 feet over it.

Anchorage.—There are a number of anchorages in the estuary and up the river; the outermost being northward of Tavoy Point, where good shelter may be obtained without being too close to Puklaji Patch.

Northward of the same patch there is anchorage in a depth of about 24 feet from 600 to 1,400 yards southward of the shoal extending from Oyster Rocks.

Anchorage in from 36 to 42 feet of water over mud may be obtained eastward of Reef Island Lighthouse with Whale Rocks in line with the east extremity of Tavoy Peninsula bearing 211°.

A berth may be taken up northeastward of Middle Island in about 36 feet of water and ½ mile north-northeastward of Button Island.

Anchorage in the fairway eastward or northeastward of Grindstone may be obtained in from 36 to 42 feet of water, and the three last-named anchorages may be reached by a vessel of deep draft.

Farther up the river there is anchorage in the fairway, about 1 mile west-southwest of the south point of Crab Island, in a depth of about 20 feet.

Off Goodridge Plains anchorage may be taken up in about 13 feet water, over mud, nearly 3 miles south-southwest of the north point of Crab Island and off Tsinbyubyin, 1½ miles eastward of the same point, and in the same depth.

Directions.—Entering the river, after rounding Tavoy Point, which is steep-to, steer 46°, and if intending to anchor northward of Puklaji, bring Button Island in line with the western extreme of Reef Island, bearing 2°, and steer for it until Kiantaung, or the center of the sandy beach fronting it bears 282°, or until Fishermen's Island bears 314°, when the latter may be steered for to the anchorage.

If proceeding to any of the anchorages farther up the river, keep Tavoy Point, bearing westward of 231°, astern until the northeast extreme of Grindstone Island is just open eastward of the east side of Reef Island, bearing 347°, when alter course to 353° to pass 400 yards eastward of Whale Rocks, and, if required, to the anchorage eastward of Reef Island.

Or continue the 353° course until ½ mile eastward of Button Islet, when alter course to 343°, which passes close to the anchorages north-eastward of Middle Island and eastward of the south point of Grindstone Island and 400 yards eastward of the northeast point of Grind-

stone Island, past which the tidal streams run strongly; if intending to anchor north-northeast of Grindstone Island the course must be altered slightly to the northward for this anchorage.

But if bound to one of the anchorages higher up the river, continue the 343° course until the northeast point of Grindstone Island is in line with the western end of Button Islet, bearing 173° , when steer 353° with this mark on astern until the southern slope of Tawantaung bears southward of 248° , when close the west bank of the river, and continue along it at a distance of 300 yards until just beyond the port tide gauge at Goodridge Plains, where there is an open space, with a tank and rest house, and anchor in 13 feet water, over mud, at low water, spring tides.

A short and handy vessel, not drawing more than 8 feet, can proceed to Tavoy, but should take a pilot at this anchorage, where there is a pilot station.

To Tsinbyubyin by the East Channel.—As the bar with a depth of about 6 feet at low water which crosses the river from Elbow Point to the southeast side of Crab Island has to be passed, the tidal rise and the draft of the vessel should be considered before proceeding to the anchorage at Tsinbyubyin.

From $\frac{1}{2}$ mile eastward of Whale Rocks steer 6° for the western extreme of Elbow Point until the northern extreme of Middle Island bears 262° , when the large fish trap at the end of the central spit, if in existence, should be in line with that extreme; then steer 344° for the left extreme of Crab Island until the projecting mangrove point next south-eastward of Elbow Point bears 71° , and alter course to 18° to pass Elbow Point at a distance of about 600 yards.

From abreast Elbow Point gradually close the east bank of the river to 200 yards, continuing at this distance until the southern end of New Island bears 240° , which is the anchorage for vessels of not over 12 feet draft, and extends off Tsinbyubyin to about 600 yards northward of the bungalow, and is 200 yards broad. The bottom is soft, and the tidal stream runs about 3 knots at half flood.

Above Tsinbyubyin local knowledge is necessary, as shoals are numerous and the channels continually alter. A steam launch can proceed from Tsinbyubyin to Tavoy, making the distance in 2 hours, by leaving at half flood near spring tides, but at neaps during the height of the rains, the flood stream is not felt above New Island.

Off Tavoy there is only room for a cargo boat to swing. The fortnightly steamer arrives at high water, turns, and moors to a pontoon which is secured to the bank.

Sailing vessels from Tavoy or Mergui during the southwest monsoon may experience difficulty in obtaining an offing, and a favorable opportunity should be taken to leave either place. In bad weather, work to windward with the anchorage under Tavoy Point, or that

under Tavoy Island, open, until sufficient offing is obtained to weather the islands of the Mergui Archipelago if bound southward, or of reaching the coast of Pegu westward of Rangoon River if bound northward.

Tides.—It is high water, full and change, at Reef Island at 10h. 26m.; springs rise $15\frac{1}{2}$ feet, neaps rise $10\frac{1}{2}$ feet; neaps range $5\frac{1}{4}$ feet. At Tsinbyubyin it is high water 18 minutes later than at Reef Island; springs rise $16\frac{1}{4}$ feet, neaps rise 11 feet; neaps range $6\frac{1}{4}$ feet. It is high water, full and change, at Tavoy Point, at 10h. 57m.; springs rise $15\frac{1}{2}$ feet, neaps rise $8\frac{1}{2}$ feet, and neaps range $2\frac{1}{4}$ feet.

Tavoy Town, the headquarters of Tavoy District, is low lying and all except the central portion is liable to be flooded at high tides; the river is on its western side, and southwest of it rice and timber mills extend along the bank for a distance of about 2 miles.

The town is well laid out, with three main thoroughfares parallel to the river, and all the Government buildings are in the center, except the jail and the military police barracks, which are situated on higher ground to the east; the houses are mostly of timber, thatched with dani palm, and the town is well wooded throughout and abounds in gardens. In 1901 it had a population of 22,371. The main wharf is about 36 miles from Tavoy Point. The rainfall is heavy, averging 190 to 220 inches annually.

Communication.—Steamers of the British India Steam Navigation Co. run weekly from the mouth of the river to Rangoon and Mergui, and fortnightly to Moulmein, Ye, and Penang. Steamers trading with Straits Settlements call frequently at Tsinbyubyin, where there is a rest house and a good road to Tavoy; there is telegraphic communication.

Supplies of various descriptions can be obtained.

Storm signals are shown at Tavoy.

Trade.—The trade, which is not of great importance, is chiefly with Rangoon, Mergui, Calcutta, and the Straits Settlements, the chief exports consisting of rice, silk, waistcloths, salt, and dani palm, and imports of raw silk, tobacco, piece goods, sugar, kerosene oil, twist, yarn, and til seed. Silk weaving is the main industry, there being about 1,000 looms; pottery is manufactured, gold and silver worked, and there are rice and timber mills.

From abreast of Nauwi Rocks the coast trends in a south-southeasterly direction for 26 miles, to Zauzi Point, and then in a southerly direction for 38 miles, to Kalwin Point, the east entrance point to Mergui.

Southward of Round Hill, 20 miles south of Tavoy River, the coast is bordered by extensive flats of sand and mud, extending in places to a distance of nearly 10 miles from the coast.

Aspect.—Ranges of inland hills, with some conspicuous peaks, extend parallel with the coast; Sharp Peak, 5,304 feet high, is the southern of the highest range.

The most conspicuous coast hills, useful for navigation, are Bouktoungji; Shetoungji, 1,500 feet high; Round Hill, 650 feet; South Hill 550 feet; Zauzi Hill, 390 feet; Flat Hill, 635 feet; and Barn Hill, 1,038 feet.

Kantu Rocks.—These two isolated rocks, 8 and 10 feet high and 1,600 yards apart in a northeast and southwest direction, are situated $5\frac{1}{2}$ miles northwestward of Round Hill.

Depths of $5\frac{1}{2}$ fathoms are found around these rocks.

Zauzi Flat, which uncovers in patches, is a large flat of sand and mud, extending 7 miles westward of the entrance to Zauzi River.

Mergui Islands extend from Tavoy Island, the north extreme of which is nearly 20 miles southward of Tavoy Point, to Sayer Islands, a distance of about 270 miles, Great Western Torres Islands, the most outlying, being about 70 miles off the mainland; there are many small barren rocks in the archipelago, usually with deep water near them. The Islands are fully described in Chapter I.

Routes.—The navigation among the islands between Tavoy and Pakchan River, a distance of about 210 miles, is almost completely sheltered for steamers and small sailing craft.

The best route for steamers is westward of Domal and Bushby Islands, through Forrest Strait, and eastward of Hastings and St. Matthew's Islands. Small vessels pass eastward of Domal and Owen Islands, but the passage near the northern part of Domal Island dries almost across at low water springs, leaving a narrow channel through sand banks, named Celerity Passage.

Depths offshore.—The bank of soundings extends for some distance outside most of the islands, but it has not been examined; although the water near some of the islands is deep, approach to them would probably be indicated by the lead.

Caution.—In passing through any of the channels or inside the islands, in addition to the use of the lead, a good lookout is imperative, as probably more reefs exist than are shown on the chart.

The channels between the outer islands are so imperfectly known that none of the central entrance channels from seaward, except Nearchus Passage, in latitude $11^{\circ} 50'$ north; Forrest Strait, in latitude $11^{\circ} 5'$ north; and Investigator Channel, in latitude $10^{\circ} 15'$ north, should be attempted. If northward of these, it is better to approach the mainland only between Tavoy Point and Tavoy Island, or, if southward, by passing south of Chance Island, in latitude $9^{\circ} 20'$ north.

Tavoy Island, situated from 11 to 17 miles from the mainland, is about 18 miles in length in a north-northwest and opposite direction,

5 miles in greatest width, and its highest part, about 7 miles from its northern extreme, is 2,245 feet high; although considered fertile, there are only a few houses and some families of Selungs settled on the island.

The western side of the island is very steep, and a string of islets and rocks extends southward for about 5 miles from its southern point. The caves in the hills of the island are the breeding places of the edible nest-building swift, and the right of taking the nests, which are exported to China, is leased by the Indian Government.

The channel between the island and the main is navigable, and affords anchorage; eastward of the northern part of the island its width is contracted to about $2\frac{1}{2}$ miles by Zauzi Bank, the 5-fathom contour of which extends about $9\frac{1}{2}$ miles from the mainland, and the depths between the edge of the bank and the island, through which the tidal stream sets with a rate of $1\frac{1}{2}$ knots at springs, are from 7 to 18 fathoms. The lead gives warning of approach to the bank off the mainland, toward which the flood tidal stream sets.

Water.—On the southeastern side of this island, near a small white pagoda, good fresh water can be obtained. This pagoda is not visible from the northward.

Port Owen, on the northeastern side of Tavoy Island, affords good anchorage protected from the eastward by Edward, William, Rich, and Campbell Islands, all connected by a shallow flat drying at low water, and farther south by a mud flat, with from 2 to 3 fathoms water over it, which extends in a south-southeast direction from these islands to within a quarter of a mile of Fisher Peninsula, which projects from the eastern side of Tavoy Island.

Depths.—The depths in the northern entrance channel are from 6 to 8 fathoms, and in the narrow channel between the extreme of the mud bank and the northern side of Fisher Peninsula, $4\frac{1}{2}$ fathoms; in the harbor they are from 7 to 13 fathoms.

Missionary station.—Port Owen is a missionary station, and fresh water and wood are easily obtained.

Tides.—It is high water, full and change, at Port Owen at 10h. 52m.; springs rise 16 feet, neaps $9\frac{3}{4}$ feet.

Tidal streams.—The flood stream sets southward through the harbor with a velocity of from 1 to 2 knots; the ebb stream sets northward at from 2 to 3 knots at springs.

Depth.—The depth in the channel northward of Fisher Peninsula is 6 fathoms.

South Island.—This narrow island, $2\frac{1}{2}$ miles in length and 800 yards in breadth, lies south of Tavoy Island. The highest summit is 540 feet high and densely wooded.

South Island is separated from Tavoy Island by an unnavigable channel 800 yards broad.

South Rocks.—This chain of rocky islets, with deep water around extends $2\frac{1}{2}$ miles southward from the south extreme of South Island.

North Rocks.—This group of three black rocks, with deep water around, of which the southern and highest is 340 feet high, and Pinnacle Rock, the northern, 150 feet high, is situated 3 miles westward of the south end of Tavoy Island.

Gray Rocks are a group of three gray rocks, of which the eastern and largest is 340 feet high, situated $3\frac{1}{4}$ miles westward of the south extreme of South Island.

Great Canister Island.—This island, situated about $6\frac{1}{2}$ miles westward of the south extreme of Tavoy Island, is 2 miles long in a north and south direction, $1\frac{1}{4}$ miles broad, and 1,084 feet high.

It is densely wooded and steep-to on the western side.

Little Canister Island.—This conical, densely wooded island, 1,000 feet high, is situated 6 miles southward of Great Canister Island.

Channels.—The channel between the two Canister Islands has a depth of 12 fathoms, and that between these islands and North and Gray Rocks is free from dangers.

Cabusa (Cabosa) Island, the northern of the outer Mergui Islands, is irregular in shape and has four principal summits, the two southern ones being the highest, 1,300 feet high. The island is 3 miles long in a north and south direction; its widest part, the southern, is $2\frac{3}{4}$ miles in width. The island is densely wooded and has deep water all around.

West Canister Islet, steep and covered with jungle, is 472 feet high. It is situated about 8 miles southwest of Cabusa Island, with Investigator Passage, having depths varying from 30 to 40 fathoms between.

Pinnacle Rocks.—An isolated patch of rocks, lying in a north-east and southwest direction, 15 and 12 feet high, are situated about $4\frac{1}{2}$ miles east of West Canister Islet; there appears to be no out-lying dangers off them.

Freak Islet, small and conical, 120 feet high, with a few stragly trees on it, is situated about 5 miles southward of the southeastern point of Cabusa Island, and nearly midway between it and Tenasserim Island.

Tenasserim Island, $10\frac{1}{2}$ miles southward of Cabusa Island, is about $3\frac{1}{2}$ miles in a north and south direction, and $3\frac{1}{4}$ miles in an east-southeast and west-northwest direction. Its peaks, of which the southern one, Tenasserim Peak, 1,620 feet, is the highest, appear at a distance like separate islands. Herbert and Howard Islands lie off its northern end, the latter being distant about $1\frac{1}{2}$ miles from it. West Islet, a small islet 350 feet high, lies off its southwestern end, and is not easily seen, as it appears to be part of the main island.

East Islet, a small islet 270 feet high, lies off its eastern end just south of it; this islet is not easily made out. Rock Islet, 67 feet high, white in appearance from the eastward, lies east-northeast $2\frac{1}{2}$ miles from Tenasserim Peak. Tenasserim Island and those adjoining it are all densely wooded, with deep water all around and no outlying dangers.

Brown Rock.—This rock, situated about 8 miles south-southwestward of Little Canister Island, is 66 feet high, with rocks which occasionally dry, situated close northward and southward of it.

Thamihla or Iron Island.—This island, situated between Kings Island and South Rocks, rises to a height of 1,203 feet near its southern end; it is 5 miles in length in a north and south direction, and 1 mile in breadth, the western side being steep-to and precipitous.

There is good anchorage on the eastern side in 12 fathoms, sand and mud bottom.

Middle Passage.—This passage between Iron Island and South Rocks is deep and free from dangers, but strong tidal streams, eddies, and overfalls are experienced, especially in the southwest monsoon.

Iron Passage.—This channel between Kings Island and Thamihla Island is deep, with strong eddies, tide rips, and overfalls, the tidal streams making through at springs at over 3 knots.

Ant Islet.—This small rocky islet, with scrub on it, 53 feet high, is situated 1 mile north of King Point, the northwestern extreme of Kings Island. Mussel Islet, 27 feet high, is situated $\frac{1}{2}$ mile southward of Ant Islet, and Melhuish Island, a small densely wooded island, 300 yards in circumference and 321 feet high, 1 mile south of it.

Two wooded islands are situated near the shore in the bay eastward of the northwestern extremity of Kings Island. Vessels using Iron Passage should keep over toward Iron Island when approaching from the westward to avoid as much as possible the strong eddies and tide rips off Ant and Mussel Islets.

Directions.—Entering from the westward, pass northward of Cabusa Island, and thence steer either for the Middle Passage or Iron Passage; in both channels care should be taken on account of the strong tidal streams and rips.

Vessels proceeding to the southward from Tavoy should pass 2 miles eastward of the north extreme of Tavoy Island, and then alter course to pass at the same distance off Cornwall Point, the eastern extremity of that island.

From thence the track, free from dangers, leads between Thamihla and Kawdwe Islands.

Marcus Group.—This group consists of four islands—Marcus, 460 feet high; Gifford, 440 feet high; Harris, 460 feet high; and Genn Island, 227 feet high. They are situated about 6 miles west-southwestward of King Point, between which there is a deep channel with depths varying from 14 to 22 fathoms. A small patch of reef lies 800 yards off Gifford Island, in a southwest direction, its highest part being 12 feet high. Harris Island appears as two islands, its northern and southern ends being only joined by a narrow strip of sand and scrub. Genn Island, the smallest and most eastern, lies 600 yards east of Harris Island; there is deep water in the channels, but strong currents and tide rips may be experienced.

Page Islet.—A small conical-shaped rock covered with straggly trees, 85 feet high, is situated 5 miles northwest of Maingay Island, and $2\frac{1}{2}$ miles south-southwestward of the Marcus Group, between which there is good water, and also between Page Islet and Maingay Island.

Maingay (Maingy) Island, off the western side of Kings Island, is $4\frac{1}{2}$ miles long in a north and south direction, and 4 miles in an east and west, the western side being high and steep-to, the hills terminating in a peak 1,970 feet high near its southwestern end. It is separated from Kings Island by a small channel, unnavigable except for boats. Its southeastern side is fringed with mangroves, off which lies an extensive mud bank, which uncovers at half tide. An island 850 feet high lies off its northeastern side, and at a distance appears to be part of Maingay Island itself, only being separated by a narrow strip of mud and mangroves. On its eastern side there is a fishing village.

Kings Island, northwestward of Mergui, is 23 miles long in a north-and-south direction, 11 miles in greatest breadth, and is about 2,800 feet in height near its northwest side; it is rich in alluvial land and fine forest trees and has a scanty population of Karens and Burmese.

Kings Island Sound is formed between the northeast part of Kings Island and Plantain Island, which is apparently a peninsula stretching northward from the east side of Kings Island; Kama Taung, at the northern end of Plantain Island, is 1,361 feet high, and 800 yards off the northwest extreme of the island is Panella Islet, 10 feet high.

The sound is $2\frac{1}{4}$ miles in width between these entrance points and extends to the southward for about $4\frac{1}{2}$ miles, but, with the exception of about $\frac{1}{2}$ mile within the entrance, it is filled by banks, which dry at low water, extending from each side, and fronted by shoal water; between these drying banks is Htein Chaung, a channel which is known to extend for about 2 miles into the island, and was

supposed to communicate with Fell Passage on the east side of the island, and to be used by canoes.

Lys Shoal, two rocky patches, the northwestern with a depth of $1\frac{1}{2}$ fathoms over it, lies 1 mile northeastward of the northern entrance point of Kings Island Sound; the southeastern patch has 2 fathoms water over it.

Clearing marks.—The southwest extreme of Thamihla Island bearing 308° , with Little Canister Islet just shut in by it, leads northeastward, and the northern entrance point of the sound bearing 248° leads southward, of Lys Shoal.

Anchorage.—The anchorage in a depth of about 7 fathoms is with the eastern extreme of the northern entrance point bearing 341° , distant nearly $\frac{1}{2}$ mile, but as this anchorage is only about 300 yards from the edge of a shoal with a depth of 2 fathoms, soundings should be taken around the vessel to ascertain that the berth is clear; vessels of light draft can anchor off the watering place, about a mile southwestward of the north entrance point of the sound.

Water.—Boats can obtain water at half flood from a stream on the northwestern side of the sound, where there is a stony beach and a small rocky islet.

Tides.—It is high water, full and change, at Kings Island Sound at 10h. 45m., and the rise of tide is from 12 to 16 feet.

In the perigee springs of February or March the tide may fall a foot lower than the datum to which the soundings on the charts are reduced.

Inner route to Mergui.—Steamers from the northern ports of Burma pass eastward of Tavoy Island, keeping about 2 miles from it to avoid the shoal water extending $9\frac{1}{2}$ miles from the shore abreast its northern point.

Mergui District, the northern limit of which is the stream discharging near Tatouk, eastward of Tavoy Island, has a coast line of about 200 miles in length to Victoria Point, and includes Mergui Harbor.

Kumla Island, a conical island 542 feet high, is 800 yards long in a northwest and southeast direction, and 600 yards broad, with deep water around it.

Kumla Patch.—A patch with a depth of $3\frac{1}{2}$ fathoms is situated 3 miles south-southwestward of Kumla Island.

Amyinpoma Islands.—These two islands, the northern of which is 467 feet high, are densely wooded; the northern island is 1 mile in length and 1,200 yards in breadth, the southern 350 feet high, 1,000 yards in length, and 800 yards in breadth; the channel between these islands is narrow, with a depth of $1\frac{1}{2}$ fathoms; shoal water and reefs extend from the mainland to these islands.

Maundrell Reef.—This isolated reef, 5 feet high, is situated $1\frac{1}{2}$ miles north-northwestward of the summit of the northern Amyinpoma Island.

Bowers Reef.—This reef is of small extent, covering at high water, and is situated $2\frac{1}{2}$ miles in a south-southwesterly direction from the summit of South Amyinpoma Island; it has depth of $4\frac{1}{2}$ fathoms on the eastern side.

Kawdwe or Long Island, 440 feet high, 1 mile in length in a north and south direction and 600 yards in breadth, is the northern and outer of a group of small islands lying off the mainland near the entrance to Mergui. The 5-fathom contour is situated 1 mile westward of Kawdwe Island, and on its eastern side is a mud and sand flat with 2 or 3 feet on it, extending 1,400 yards in a southeasterly direction.

Kawdwe Rock.—This isolated patch of rocks of small extent, 4 feet high, is situated $3\frac{1}{2}$ miles southward of Kawdwe Island.

Daisy Rocks are a group of isolated rocks, 22 feet high, lying 1.1 miles eastward of Kawdwe Island.

Cone Islet.—This small conical islet, 127 feet high, is situated 1,400 yards east-southeastward of the southern point of Kawdwe Island.

Galbraith Rock.—This isolated rock, which covers at high water, is situated about 4 miles northeastward of Kawdwe Island, and has a depth of 8 to 9 feet around it.

Pyin-ban Rocks.—This narrow ridge of rocks, 1 mile in length in a north and south direction, the highest being 87 feet high with patches of scrub, is situated 4 miles southeastward of Kawdwe Island.

Peak Islet.—This islet, forming the southern extremity of Pyin-ban Rocks, is 118 feet high.

White Rock.—This white rock, 14 feet high, is situated about 2 miles southward of Peak Islet, and 1,800 yards farther south is a rocky patch which dries 10 feet.

Gladys Island, 338 feet high, is the northern of an inner group of islands; from seaward these appear to be part of the mainland, from which they are only separated by narrow creeks and mud banks.

Thitya or Barn Islet is a square, precipitous rock 86 feet high. Cap Rock, 22 feet high and small, lies $1\frac{1}{2}$ miles northwestward, and High Rock, 37 feet high, $3\frac{1}{2}$ miles northeastward of Thitya.

A sand bank with 5 feet over it at low-water spring tides, lies nearly 3 miles south-southwestward of Thitya Islet and close to the channel leading to Mergui; eastward of this bank the water is shoal.

Northern approach to Mergui—West side.—Kala Island, separated from Plantain Island by Fell Passage, a channel about $\frac{3}{4}$ mile wide, is nearly $7\frac{1}{2}$ miles in length, with an average breadth of 2

miles, and 429 feet high at its northeast end; it is bordered by mangroves and has several hills along its western shore.

On the western side of the northern entrance to Fell Passage, and 2 miles northward of Kala Island, is Sa, a small steep island, 322 feet high, and northward of Kala Island, forming the eastern side of the entrance to the same passage, are flats, which dry, fronted by a shoal, the whole extending for $2\frac{1}{2}$ miles; Kawmwe Islet, about 400 yards in extent and 200 feet high, is situated on the north extreme of the eastern of the drying flats.

East side.—Kalwin Point is the northwest extreme of Mergui Island, and the south entrance point to Kiaupi River, the channel into which, northward of Kalwin Point, is only about 200 yards in width, and from its northern side the edge of a shoal extends about $9\frac{3}{4}$ miles in a north-northwest direction, forming the eastern side of the channel of approach to Mergui Harbor.

With the exception of a channel, with depths of from 4 to 15 fathoms, which runs along the eastern side of Kala Island nearly to its south end, the whole of the space southward of a line joining Kawmwe Islet and Kalwin Point is filled with islands, banks which dry, and shoals.

Light.—A fixed white light is exhibited at an elevation of 25 feet above high water, from an iron pile beacon, painted white above and red below high-water mark, placed in a depth of 10 feet off Kalwin Point; the light is visible 9 miles.

Outer anchorage.—The outer anchorage, in mid-channel of the approach to Mergui, is in depths of from $5\frac{1}{2}$ to 6 fathoms, and from about $1\frac{1}{4}$ miles to 1 mile distant from the light beacon, with Patawtaung Hill on Madramakan Island, bearing between 170° and 181° .

Mergui Harbor.—Madramakan Island, situated in the southeast corner of the shallow area between Kala and Mergui Islands, is nearly 2 miles long in a north-northwest and opposite direction, and 1,800 yards wide; Patawtaung Hill, 785 feet high and crowned by a pagoda, is near its northern end, and at its south point is Patitaung, 264 feet high, also having a pagoda on its summit.

The eastern side of Madramakan Island with the western coast of Mergui Island forms Mergui Harbor, which, although $\frac{1}{2}$ mile in length in a north and south direction and 600 yards in width, is much reduced by low and shelving rocks extending about 250 yards from Madramakan Island, and detached heads, one of which dries $3\frac{1}{2}$ feet at low-water spring tides; on the eastern side, a shoal spit, with depths of from $2\frac{1}{4}$ to 3 fathoms over it, nearly divides the anchorage, stretching about halfway across the harbor, and shoal water extends from Mergui Island on the southern side of the anchorage.

Entrance.—The entrance to Mergui Harbor is on the eastern side of the shoal area already mentioned, and about 400 yards westward of the light beacon, thence the channel, with a south-southeast and south direction, is from 300 to 500 yards from the west coast of Mergui Island.

Depths.—The least depth in the entrance is $2\frac{1}{2}$ fathoms and about $1\frac{1}{2}$ fathoms in the channel, and there are from 3 to 6 fathoms at the anchorage.

Range marks.—The front range mark, painted white and surmounted by a white triangle, is situated on the coast about $1\frac{1}{2}$ miles southward of Kalwin Point.

The rear mark, painted white, surmounted by a white ball over a white and black diamond, is situated on a hill, about 100 feet high, 1,620 yards 159° from the front mark.

These marks in line lead through the entrance and into the channel.

A third mark, painted white, and surmounted by a diamond, is situated at the southwest corner of the market, 1,980 yards 192° from the front range mark.

Inner anchorage.—The anchorage off Mergui has an area of about 1 square mile with depths of from 18 to 40 feet. Vessels drawing less than 18 feet should anchor with the main wharf bearing about 113° distant, about 300 yards, and larger vessels farther south; it is advisable to moor.

The Pool, a small area of deep water off the eastern extreme of Madramakan Island, affords good anchorage for vessels of deeper draft, but the tides and eddies are very strong here.

Directions.—Approaching Mergui Harbor from the northward, Kings, Plantain, and Thamihla Islands show as one lofty island, and from a position midway between Thamihla and Kawdwe Islands steer 167° for the eastern extreme of Plantain Island, which is steep, and when Thitya Islet bears 113° steer 150° for Patawtaung Hill.

When the northeast extreme of Plantain Island bears 312° , and is almost touching the southwestern extreme of Thamihla Island, alter course to 132° , keeping this mark on astern, which leads direct to the anchorage from 1 mile to $1\frac{1}{2}$ miles northwestward of Kalawin Point.

For Mergui Harbor.—Without local knowledge the channel to Mergui should not be entered by a vessel of 10 feet draft until after the first quarter flood, or till after half flood if drawing more than 10 feet; with local knowledge, and at neap tides, a vessel of 15 feet draft may enter after the first quarter flood.

When approaching steer for Kalwin Point Light, and when the two first range beacons are in line bearing 159° , steer for them until the eastern end of the deputy commissioner's house (marked with a white line) is in line with the market range mark bearing 175° .

Steer on this line until abreast a narrow wooden pier near the northern mill, when alter course to 191° .

Tides.—It is high water, full and change, at Mergui at 10h. 29m.; springs rise 18 feet 1 inch, and neaps 11 feet 2 inches; neaps range 4 feet 5 inches.

Tidal streams.—The rate of the tidal streams at half tide, at springs, is about 2 knots during the dry season; the rate of the ebb is probably more during the rains. The flood stream sets southward, the ebb northward.

Mergui, the most important town in the southern province of Burma, and the headquarters of a deputy commissioner, is on the western side of Mergui Island, which is separated from the mainland by the Tenasserim River and one of its numerous creeks.

It stretches for more than 1 mile along a muddy shore, over a small ridge, and down its farther side, and has wooden houses mostly roofed with galvanized iron, displacing the old thatched roof of palm leaves. Bungalows on the hills, surrounded by trees and flowers, and its white pagodas give it a picturesque and pleasing appearance from the anchorage; its population, which is increasing, was 14,889 in 1913.

Communication.—The British India Steam Navigation Co. has a service of steamers calling weekly at Rangoon and Tavoy River, and fortnightly services from Rangoon, Tavoy River, Palau, Bokpyin, Victoria Point, Moulmein, and Penang. There is telegraphic communication between Mergui and Victoria Point.

Creeks are the usual means of traveling inland, roads are few. Carts are available only at Palau (to ply to Pala), and in Mergui Town. Boats can be had in Mergui, Bokpyin, Palau, and Victoria Point. Elephants are available at Palau and Tenasserim.

Supplies.—Fresh meat, bread, and vegetables, also rice, fish, salt, oil, and oilman's stores are obtainable. Coal and fresh water in limited quantities can be obtained by arrangement with Messrs. Bullock Bros. who are agents for the British India Steam Navigation Co.

Hospital.—There is a hospital into which seamen are admitted, an entrance fee being paid by the master of the vessel.

It contains about 30 beds and is in charge of the civil surgeon, assisted by a subassistant surgeon.

Storm signals are shown at Mergui.

Trade.—The chief exports are fish paste, mother-of-pearl shells, and timber, and the imports cotton piece goods, husked rice. The pearl fisheries of the island constitute a considerable portion of trade, the pearls being noted for color and luster.

Climate.—The climate, though warm and humid, is considered healthy.

Southern approach to Mergui.—The islands in the southern approach to Mergui Harbor are:

Northern side.—**Burnett (Tada) Island**, $\frac{1}{2}$ mile southeastward of the southern end of Kings Island, is about $3\frac{1}{4}$ miles long in a north and south direction, of irregular width, and low.

Shrub Rocks, 23 feet high, lie on the southeast extreme of a shoal which extends nearly 1 mile in a northwest direction, and are nearly $1\frac{1}{4}$ miles west-southwestward of the southern point of Burnett Island.

Pyin (Thamihla) Island, $1\frac{1}{4}$ miles northeastward of the northeastern point of Burnett Island, is about $\frac{1}{2}$ mile in extent, 293 feet high, and stands on a mud flat joining Burnett and Bertie Islands.

Bertie (Ma-ing) Island, about 1 mile northeastward of Pyin Island, is about 3 miles in length and the same in width, and all covered with low mangroves, except a wooded hill about 200 feet high at its southeast point; a point of the mud bank mentioned extends about $1\frac{1}{4}$ miles eastward of the island.

Limlor (Arabann) Island, about 1,200 yards long in a northeast and southwest direction, 400 yards broad and 204 feet high, is on the southeastern corner of the mud flat off Bertie Island and opposite the entrance to Kwan Thaung Wa Channel leading into the southern entrance of Tenasserim River. There is good anchorage in depths of from 7 to 8 fathoms immediately southward of this island.

Thitya Island, separated from Bertie Island by a narrow channel, is triangular in shape, about $1\frac{1}{2}$ miles in length in a northeast and southwest direction and nearly 1 mile wide at its broadest end; it is bordered by mangroves, but has hills about 60 feet high at its northeast end.

Southern side.—**North Round Island**, $\frac{1}{2}$ mile southward of the southern end of Burnett Island, is about 600 yards in length in a north and south direction, 200 yards wide and 243 feet high. A shoal with $2\frac{3}{4}$ fathoms water over it lies about 1 mile northeast, and a rock, drying 9 feet, lies $1\frac{1}{4}$ miles eastward of North Round Island.

South Round Island, $\frac{1}{2}$ mile farther southward, is 136 feet high, and rather smaller. The bottom appears to be foul between these islands and Merghi Islands, to the southward.

Merghi Islands, southward of Burnett Island, are two in number, bold and lofty. The highest summit, 1,646 feet high and pyramidal, is on the southwestern island. A shelving mud bank, with only 3 fathoms over it $1\frac{1}{4}$ miles from the southern island, extends westward of them.

Thetyagi Islet is about 2.7 miles east-northeast of North Round Island. Two islets or rocks, the northern of which is 80 feet high, lie $\frac{3}{4}$ mile northward of Thetyagi Islet, on the same bank, which dries.

Balu (Thetyangai) Islet is 341 feet high and has a small summit at its southwestern end; the mud dries all around and 1 mile westward of this islet at low water.

Letsari Islets, $3\frac{1}{2}$ miles northeastward of Balu Island and eastward of Bertie Island, are two in number, $\frac{1}{2}$ mile apart in a northeast and southwest direction; the southern islet, which is on the northern end of a large mud bank, is 195 feet high, the northern in the middle of the channel northward of the bank, 82 feet, and both are thickly wooded.

The mud flat extends southward from South Letsari Islet to within 400 yards of Falle Islet, which is the northern of several haycock-shaped islets. This mud flat forms the eastern boundary of the southern entrance into Mergui and the northern boundary of what appears to be a fairly deep channel into Tenasserim River.

Entrance—Depths.—The southern entrance to Mergui Harbor is between Shrub Rocks and Burnett Island on the north and North Round Island on the south side, and between the two latter it is about 600 yards in width; this route saves a detour of about 15 miles to vessels of light draft coming from the southward.

The depths, from 12 to 20 fathoms at the entrance, at 2 miles within shoal to $3\frac{1}{2}$ fathoms, above Limlor Island to $1\frac{1}{2}$ fathoms and above the southern Letsari Island to $\frac{1}{2}$ fathom, and in some parts of the channel there is only 1 foot or 2 feet at low water, spring tides; vessels of 8 feet draft can use it at high water.

Directions.—Cantor (La-e-Kabyatt) Island is situated 7 miles southwestward of the southern end of Kings Island, on the northern side of the entrance, and when its south end bears 316° , distant 2 miles, steer 48° with the southern end of Burnett Island on the starboard bow, and when $1\frac{1}{2}$ miles distant from Shrub Rock alter course to pass midway between the southern end of Burnett Island and North Round Island, remembering that the tidal streams at springs are strong.

From the southern end of Burnett Island steer 42° for about $3\frac{1}{2}$ miles, or until the eastern extreme of Pyin Island bears 12° , when alter course to 68° and pass 400 yards southward of Limlor Island; continue on the same course until the southern extreme of this island bears 271° , then steer about 39° with Patawtaung, the highest land in this direction, nearly ahead. This channel is marked by fish traps on either hand, and the fairway is midway between them.

Above North Letsari Islet, the mud flats extending off the southern side of the entrance to Kan-bi-sat Creek, on the east, and Thitya Island, on the west, nearly join, and the channel between them is divided by a bank which dries 2 feet, leaving narrow channels on each side, in which there is a depth of 12 feet at high water neaps,

the fishing stakes showing the sides of the channels; the eastern channel may be the better of the two as the mud flat on that side has more water over it than that off Thitya Island.

When Kan-bi-sat Creek entrance bears 91° steer about 336° until just past the fish trap on the eastern side of the channel and 2 miles south-southeastward of Kale Island, then steer about 47° for the northern end of Madramakan Island, passing between the fish trap and Greenwich Reef, a patch of rocks that dries at half tide, lying nearly $1\frac{1}{4}$ miles southward of Kale Island.

When past the sand spit and the southern point of Madramakan Island bears 105° , steer toward that point, rounding it at a distance of 300 yards, and thence for the anchorage off the main wharf.

Tenasserim Village, situated on low ground at the confluence of the Great and Little Tenasserim Rivers and 33 miles southeastward of Mergui, is built along the slopes of a hill, in mountainous country, on the site of the ancient city which was for several hundred years the principal port of Siam. The courthouse stands on a height above the village, and on the same hill are two ancient pagodas; the village barely contains a hundred houses.

A few miles below the village a reef of rock stretches across the river, which, even during the rains, is impassable by a vessel drawing more than 6 feet. The temperature is variable, and the climate unhealthy.

Tenasserim River has several mouths, the two principal of which are separated by Mergui Island; the banks of the river are in places very steep, and the channel is in parts narrow, but large boats can ascend as far as Tenasserim Village, the river being tidal for 10 miles above this.

Fell Passage, on the eastern side of Kings Island, and used by vessels proceeding through the archipelago, is 19 miles in length, the channel being narrow and running through the mud banks that lie between all the islands, but with a rising tide it is by no means difficult.

Northern entrance—Depths.—Sa Islet, about $\frac{1}{2}$ mile off the eastern side of Plantain Island, has been already mentioned; it is 322 feet high, about 100 yards in extent, and, with a smaller islet off its northern side, forms the western entrance point to Fell Passage.

The eastern side is formed by the point of a stony shoal, with from $1\frac{1}{4}$ to $2\frac{3}{4}$ fathoms water over it, which extends nearly $2\frac{1}{2}$ miles north-northwestward of the north point of Kala Island, and the width of the channel between these is about 600 yards.

The depth at the entrance is $4\frac{1}{2}$ fathoms, decreasing to from $3\frac{1}{2}$ to 4 fathoms within, which depths are continued for about $6\frac{1}{2}$ miles to the northern extreme of Yemyok Island, after which the least depth is $2\frac{1}{4}$ fathoms, but about midway through the channel and

between Pigale and Thanpo Islands there is a patch of $1\frac{1}{2}$ fathoms, difficult to avoid; at high-water neap tides the depth is not less than $3\frac{1}{2}$ fathoms in the passage.

Directions.—Approach Sa Islet with its eastern end bearing 203° to a distance of 400 yards, pass the same distance eastward of the islet, and then steer 195° . On approaching the northwestern elbow at Kala Island keep rather over to that side until the channel between Yemyok and Kings Islands opens, when gradually haul over to the western side of the channel to clear a shoal with a depth of $1\frac{1}{2}$ fathoms, the edge of which extends from the north point of Yemyok Island in a northeast direction to Kala Island.

Yemyock Island, covered with mangroves, has a spit that dries 600 yards off its northern end, and the western shore should be kept, past a large double creek that does not dry, and until Sakone, a small, round, wooded islet, 148 feet high, is open westward of Yemyok Island, bearing about 189° .

From this course should be altered gradually to bring and keep Sakone Islet bearing 184° and open eastward about twice its own breadth of Bare Island, which has a rounded bare summit 148 feet high, and, when about $\frac{1}{2}$ mile southward of the latter, keep the eastern side of Bare Island in line with the western side of Yemyok Island, bearing about 26° , as a stern mark, steering 206° until the north end of Payegyun is abeam, when keep sufficiently to the southward to open the above islands, and, passing Bare Island at the distance of 200 yards, steer about 211° for Pigale Islet, which is small and 95 feet high.

There is a passage on either side of Pigale Islet, the eastern, although the narrower, being more direct, is easier when going southward, and preferable for short vessels.

Rocky spits project north-northeastward and eastward of Pigale Islet, and when the northern end of that islet bears 254° keep in mid-channel, leaving a beacon, consisting of a pole surmounted by a basket, which marks the end of the rocky spit extending eastward, to the westward, and pass along the eastern side of the bank which surrounds Thanpo Island and extends southward of it 300 yards distant, and the northwestern end of Gyunthaung 400 yards.

A shoal of sand and shells, with a depth of $2\frac{3}{4}$ fathoms over it, lying in midchannel $\frac{1}{2}$ mile southwestward of the western extreme of Gyunthaung, is cleared by borrowing on the western side, and the track now leads midway between Kings Island, on the north, and Burnett, Fell, and Passage Islands, on the south. Between the first named the eddies at springs are strong.

Water can be procured on Kings Island, northward of Fell Island, but the mouth of the stream is not noticeable.

Southern entrance—Depths.—The southern entrance to Fell Passage, between the south extreme of Kings Island on the north, and Passage, Fell, and Burnett Islands on the south, is about 800 yards wide between the 5-fathom contour. The southern end of Kings Island terminates in a bay, between the headlands of which the water is shoal.

The depths in this entrance are from 10 to 16 fathoms.

Fell (Tadagyí) Island is 797 feet high and has two summits, the western being the higher.

Lah-chi Islets, a group of five, lying southward of Fell Island, are of conical shape from 136 to 146 feet high, except the northern islet, which is 304 feet high.

Passage (Tadange) Island, over 1 mile southwestward of Fell Island, is 370 feet high, and has a nearly level summit with a slight saddle in the center. A mud bank with depths of from $2\frac{1}{2}$ to 3 fathoms extends about 1,600 yards westward from it.

Directions.—Vessels proceeding to the northward through Fell Passage should reverse the directions already given until Gyunthaung Island is passed, and then around the northeastern part of Thanpo Island, southwestward of Pigale, 300 yards distant, to avoid a shelving gravel bank off it, and when the eastern side of Myi-ni Islet (113 feet), which is next north of Thanpo Island, is nearly in line with the bare summit of Bare Island, bearing 35° , steer 57° until the eastern side of Bare Island is in line with the western side of Yemyok Island bearing 26° , when reverse the previous directions. The $1\frac{1}{2}$ -fathoms shoal in this channel is composed of gravel.

Tides.—In Fell Passage it is high water at the same time as at Mergui. The diurnal inequality is large, the tide lagging at neaps for 2 hours and gradually lessening to half an hour toward springs.

Tidal streams.—The flood tidal stream enters the passage at both ends, meeting about 1 mile northward of Bare Island. Between Passage and Christmas Island, 20 miles southwestward, the general set of the flood stream is easterly. In the vicinity of Shrub Rocks, the indraft of the flood to the eastward is very strong at springs.

Bentinck route.—This route, shown by a pecked line on the charts, is from the southern entrance to Fell Passage, and crossing the mud bank extending westward of Passage Island, joins the track of the southern route to Mergui Harbor.

Pass $\frac{1}{2}$ mile northwestward of Passage Island, and bring the southwestern point of Kings Island in line with the sharp peak of Maingay Island, bearing 340° , steering 160° with this mark on astern, and when Shrub Rocks, 23 feet high, bear 46° , steer 229° until the southern extreme of Cantor Island bears 316° distant, about $1\frac{1}{2}$ miles, when alter course to 222° to pass about 1 mile northeastward of Christmas Island.

The double peak on the southern end of Ross Island, kept well open of the southern extreme of Cantor Island, bearing 248° leads southward of the shoals extending eastward of the latter. Small vessels cross the banks by keeping the eastern side of Passage Island open of Fell Island, bearing 34° .

Between Cantor Island and Hext Rock guard against being set to the southward.

Johnny Island, 490 feet high, lies in an east and west direction $1\frac{1}{2}$ miles, and its greatest width $1\frac{1}{4}$ miles, is densely wooded, its coast, indented by small shallow bays, fringed with reef; a good anchorage can be obtained 1 mile off its southwestern point in 5 fathoms.

Inside the triangle formed by Maingay, Macleod's, and Johnny Islands there are six small islands, all much the same in appearance, and densely wooded. Wilson Island, the highest, is 345 feet high; Evans Island, 343 feet high; Robert Scott Island, 196 feet high; and Peter Scott, 160 feet high, forming one group; between them and Johnny Island, and 2 miles north of the latter, is Wood Island, 180 feet high, and Daughlish Island, 225 feet high. A rocky patch, which covers at high water, lies 800 yards north of Wilson Island, and off the southeastern point of Robert Scott Island the reef extends 600 yards in the same direction. An isolated rock, covering at high water, lies 600 yards due north of Wood Island, and the reef off its southern end extends for 400 yards. The reef off the western end of Daughlish Island extends for some distance, also off the southeast end; there is also a detached reef $\frac{1}{4}$ mile northwestward of this island. Great caution should be exercised when navigating in these waters, as owing to the irregular depths and nature of the surrounding islands other dangers may exist beyond those already charted. Tide rips and cross currents are experienced round these islands.

Julia Island is situated 1,600 yards south-southeast of the southeastern point of Johnny Island, and is $1\frac{1}{2}$ miles long in a north and south direction, and $\frac{1}{2}$ mile in width, 300 feet high, but with no conspicuous summits. Between it and Johnny Island are two small islets, the largest being 260 feet high.

Polly (La-e) Island, south of, and practically joining, Julia Island, is $2\frac{1}{4}$ miles long in a north and south direction, and has a conspicuous summit, 727 feet high, conical in shape from the northward, and appearing over Johnny Island. Both this island and Julia Island are densely wooded.

Bound Island, 4 miles west-southwestward of Passage Island, is 203 feet high and rounded. Mouse Islet, small, conical, and 173 feet high, lies 1 mile westward, and Lump Rock, 20 feet high, $1\frac{1}{2}$ miles southwestward of Bound Island.

Medina Patches, 1 mile eastward of Bound Island, are $1\frac{1}{2}$ miles in length in a northwest and southeast direction and have a least depth of $1\frac{1}{2}$ fathoms, over gravel, at low water. They lie on a bank with depths of $3\frac{1}{2}$ to 5 fathoms, over sand and mud.

Cantor (La-e-Kabyatt) Island, 359 feet high and irregular, is $1\frac{1}{2}$ miles long in a north and south direction. A rock, with 6 feet over it at low water, spring tides, lies 1.3 miles east-northeast of its southern point, and there is foul ground between the rock and the island.

Hext Rock, 4.3 miles southward of the southern end of Cantor Island, is 500 yards in extent, has $1\frac{1}{2}$ feet over it at low water, spring tides, and is generally indicated by a ripple. Polly Island Peak, in line with the summit of Cantor Island, bearing 2° , leads westward of the rock.

Ross (DOUNG) Island is nearly 11 miles long in a north-northwest and opposite direction, and lies 7 miles westward of Cantor Island. Its southeastern point rises to a double summit 806 feet high.

Water.—Very good water can be obtained at Waterfall Cove, which is 1 mile west-southwestward of the northern end of Hel-fer-Island, on the eastern side of Ross Island. Boats at half tide can lie close to the water, which falls into the sea.

Christmas (Myauk-kaung) Island, 8 miles southward of Ross Island, is the northwesternmost of three islets and several rocky patches. Its summit is 466 feet high, and the islet may be passed on its western side at a distance of $\frac{1}{2}$ mile. Eastward and south-eastward of the islets are several shoal patches.

Single Rock, 10 feet above water, lies $2\frac{3}{4}$ miles northeastward of Christmas Island. In this vicinity the flood tidal stream must be guarded against at night.

Tides.—It is high water, full and change, at Christmas Island at 10h. 44m.; springs rise 16 feet, neaps $9\frac{1}{2}$ feet.

Coast.—The coast to the southward of Mergui is low and swampy in places, and several rivers navigable only by boats, flow into the sea through narrow channels bounded by flats. The higher ridges or hummocks, many of which appear to have been islands, now united by the soil brought down by the rivers, are generally covered with large trees.

Auckland Bay.—The northern end of Sellore or Thalo taung tan (Yengan) Island is $2\frac{3}{4}$ miles southeastward of the southern Merghi Island, and the northern part of Sellore Island, with the land to the eastward and Pa Wut Island to the northward, forms Auckland Bay, which is well sheltered with anchorage in depths of from 4 to 12 fathoms, over mud. Auckland Bay has not been surveyed, and in entering it caution is necessary.

Directions—Christmas Island to Forrest Strait.—Except in the vicinity of West Passage Island, eastward of the northern end of Bentinck Island, there is, so far as is known, deep water between Christmas Island and Forrest Strait, but as the channels have been only partially examined caution is necessary, and the lead should be used.

From 1 mile westward of Christmas Island steer 177° to pass between Cap and Feathers Rock and West Passage Island, which course leads nearly midway between Warning Rock and a reef which covers at low water, neap tides, and lies $5\frac{1}{2}$ miles south-southeastward of Christmas Island; in shaping this course the tidal streams, which here set northeast and southwest, must be allowed for, the lead being of little use owing to the depth.

In the vicinity of West Passage Island and southward of a sunken rock, the position of which is about a mile northward of the island, but is doubtful, the deepest water is near the island. Pass $\frac{3}{4}$ mile eastward of South Passage Island, and 1 mile eastward of Bluff Point, the southeastern point of Bentinck Island.

Bring Bluff Point in line with the western end of South Passage Island, bearing 3° , and steer 183° with this mark astern, passing 1 mile westward of Fly Rock, until Fly Islet bears 91° , when steer midway between the rocks off Five Sisters Group and Cone Islet off Bushby Island, and, having passed the latter, shape a 153° course to pass 4 miles eastward of Father and Son, and about 2 miles westward of High Island. The tidal streams near Bushby Island are strong and must be allowed for.

South Passage Island not being easily distinguished from the southward, Father and Son well open westward of Cone Islet off Bushby, bearing 179° , or Cone Islet open westward of Bushby Island 180° , leads westward of Fly Rock.

Anchorage.—During the dark, rainy nights which occur in the southwest monsoon, there is anchorage for a steamer in depths of from 6 to 8 fathoms, about 2 miles to the eastward of Bentinck Island, and midway between South and West Passage Islands. There is also anchorage in Forrest Strait to the eastward of Sullivan Island and south-southwestward of High Island, in depths of from 7 to 8 fathoms.

The Outer or Western Islands of Mergui Archipelago extend about 60 miles southward and south-southwestward from Tenasserim Island, and they are generally similar in appearance, high, steep, and covered with dense jungle and foliage.

Very few of the islands or the channels between them have been surveyed, and unknown rocks and reefs may exist.

Saurin Island, 585 feet high, is situated about 5 miles southwest by south of Tenasserim Peak, and two smaller islets, Ramsey Islet,

348 feet high, and Morgan Islet, 175 feet high, lie eastward of Saurin Island, $2\frac{1}{2}$ and $4\frac{1}{2}$ miles, respectively. There is deep water between these various islands and Tenasserim Island, but the currents are irregular, and tide rips are experienced.

Blundell Island, 934 feet high, $2\frac{1}{2}$ miles long in a north and south direction, and $1\frac{1}{4}$ miles in width, is situated about 6 miles south by west of Tenasserim Peak; off it, and $1\frac{1}{2}$ miles eastward of its southern point, is Chevallier Islet, 358 feet high, and south of Chevallier Islet 800 yards distant is Chevallier Rock, an isolated patch 6 feet above high water. There is good water all around Blundell Island.

Lion Rock, 130 feet high, sparsely covered with jungle, is situated $1\frac{1}{2}$ miles south of Blundell Island, the channel between them having a depth of as much as 40 fathoms.

Mermaids Passage, 6 miles in width, with depths varying from 30 to 40 fathoms, is situated between Lion Rock and the north end of Sir Charles Metcalfe Island.

Elphinstone Island, about 12 miles long in a northeast and opposite direction, and 6 miles wide, is about $7\frac{1}{2}$ miles southeastward of Blundell Island, and is the largest of the many islands forming the center group of the archipelago. The island is very irregular in shape, the coast largely indented by bays, the largest one at its north being called Port Maria.

On its western side there is another large bay, $2\frac{1}{2}$ miles in length, $\frac{1}{2}$ mile wide at its entrance, running in a northeastern direction, and terminating right under Mount Elphinstone (Elphinstone Peak) at its northern end, and Peak (False Elphinstone) at its eastern end.

The island is densely wooded and hilly, the most prominent hills being Mount Elphinstone (Elphinstone Peak) at its northwestern end, 1,750 feet high, which from the northward appears as a separate conical-shaped island, and about $1\frac{1}{2}$ miles to the eastward and southward is Peak (False Elphinstone Peak), 1,415 feet high.

Port Maria, a large inlet at the northern end of Elphinstone Island, extending about 5 miles in a south-southwest direction, with a width at its entrance of about 3 miles, is well sheltered, and affords good anchorage in 7 fathoms, with Crab Rock and Mount Elphinstone (Elphinstone Peak) in line bearing about 261° .

The eastern side of Port Maria is steep-to, the hills extending down to the high-water line; at its southeastern end there is a bay with little water.

Its western side is irregular and broken, with numerous small islets. Castle Island, at its entrance, forms the western spur of the harbor, and Burne Island forms the eastern spur.

Directions.—From the northward or westward a vessel can enter by either channel formed by Entrance Island and Castle and Burne Islands, and after passing Entrance Island a course should be

steered directly into the harbor, keeping more over to the eastern side until the bay at its southwestern end opens and the transit (Crab Rock in line with Mount Elphinstone, bearing 261°) comes on, when a good anchorage in 7 fathoms can be obtained.

Tides.—The tidal currents are weak, flood running in and the ebb out, but care should be taken when passing through the outer channels, as cross currents are experienced.

North Direction Island, a small island 150 feet high, its southern end being the highest, is situated 9 miles east-northeastward from Blundell Island.

South Direction Island, 311 feet high, is situated $9\frac{1}{2}$ miles east by north from Blundell Island; there are two small rocks 600 yards off its south point lying in a southwest direction. There is a deep-water channel between North and South Direction Islands.

Castle Island.—An island of irregular shape, with three summits 470 feet high, forms the northwestern entrance of Port Maria. About $\frac{1}{2}$ mile to the south-southwestward lies Sack Island, 460 feet high; again to the southward of Sack Island, at a distance of 800 yards, are two small islets, 116 and 185 feet high, respectively; these islands all appear to be a part of Elphinstone Island when approaching from the northward.

Oublee Rock, an isolated rock, 53 feet high, is situated 8 miles eastward of the south end of Blundell Island, with another rock awash at high water 1,200 yards east by north; there appears to be deep water all around and close-to.

Saddle Island, a small island 400 yards long in a northeast and opposite direction and 300 yards in width, is situated 5 miles southeast by east from Blundell Island. A reef extends 200 yards off its southwestern point.

Entrance Island, marking the entrance to Port Maria, is 218 feet high; to the eastward and southward a reef extends about 400 yards, the eastern portion just covering at high water.

Bowers Island is a small island, steep, 245 feet high, situated 8 miles west of Maingay Island summit.

Corbin Island, irregular in shape, 447 feet high, 2 miles long in a north by east and opposite direction, and 1 mile in width, is the northern of the group of islands of which Elphinstone Island, Macleod, and Grant Islands form a part. It is situated $5\frac{1}{2}$ miles west-southwestward of Maingay Island summit, and on its eastern side, 1 mile distant, is Hayes Island, 300 feet high. There is deep water between these islands and both are densely wooded.

Burne Island, a narrow island, 360 feet high, is 1,600 yards in length in a northwest and southeast direction, and 400 yards in width, and is situated 2 miles east by south from Entrance Island;

off its southeastern point there are three small islets, the smaller and most distant one being 800 yards off.

Macleods Island.—Situated off the northeastern end of Elphinstone Island, irregular in shape, and the coast indented by small bays, which mostly dry at low water, is $2\frac{3}{4}$ miles long in an east and west direction and $1\frac{1}{4}$ miles wide. The island is densely wooded and hilly, but has only one conspicuous summit, 568 feet high, situated on its northwestern side; off the northeastern point there are two small islets which at low water are joined to the mainland by sand and coral reef.

Between this island and Corbin Island the channel has depths varying from 19 to 30 fathoms; tide rips, overfalls, and variable currents are experienced.

Swirl Rock is an isolated patch of rock 5 feet high, situated 1 mile off the eastern side of Macleods Island; shoal water extends in a south by east direction for 1,400 yards; between this rock and Macleods Island the channel has depths of from 12 to 18 fathoms.

Eastern Bay.—A large bay off the northeastern end of Elphinstone Island is formed by Macleods and Grants Islands, and to the eastward by Allans Island, 510 feet high; Patons Island, 400 feet high; Oates and Bomford Islands, 220 feet high. The depths inside the bay are irregular, varying from $4\frac{1}{2}$ to 20 fathoms, and inside there are numerous small islands, the largest being Christobel Island, nearly in the middle, and Sylvia Island, 295 feet high, on its northern side. The northern entrance lies between Elphinstone Island and Macleods Island, is only 1,200 yards wide, and should not be attempted, owing to rocks and foul ground lying off the northeastern end of Elphinstone Island. Great caution should be used when entering from the eastward between Macleods and Bomford Islands.

A rock exists off the north end of Oates Island, with that island bearing 68° , distant 200 yards; this rock only uncovers at low water.

Grants Island is a large island, hilly and densely wooded, with no conspicuous summits. It is situated on the eastern side of Elphinstone Island, to which it very nearly joins, is irregular in shape, its coastline being indented with small bays, which mostly dry at half tide.

The channel between it and Ross Island, which is situated 2 miles to the southward, has depths varying from $3\frac{1}{2}$ to 15 fathoms, the deepest water being close to Grants Island.

Haycock Island.—The largest of a group of small islands and rocky patches, conical in shape, steep-to, and densely wooded, is 705 feet high. It is situated off the northeast end of Ross Island and 5 miles 260° from Polly Island Summit.

Sir Charles Metcalfe Island, about 3 miles in length in a northeast and opposite direction, and 1,350 feet high, is about $7\frac{1}{2}$ miles

south-southwestward of Blundell Island, and Smart Island, about 880 feet high, is between it and the east end of Elphinstone Island.

West and East Spur and several rocks are situated about 1 mile southward of Sir Charles Metcalfe Island, with Brunette and Greenlaw Islands eastward of them; these latter islands are about 890 and 530 feet high, respectively.

Bailey Island, 1,163 feet high and $7\frac{1}{2}$ miles south-southwestward of Sir Charles Metcalfe Island, is about 2 miles in extent.

Hattrass Passage, between West and East Spur and Bailey Island, is about 6 miles in breadth, and has depths of from 31 to 35 fathoms charted on its northern side.

H. Prinsep and Sargent Islands.—Tower Rock, 25 miles west-southwestward of Ross Island, on the north point of H. Prinsep Island, is an excellent landmark. Sargent Island is about 1,200 feet high, and higher than H. Prinsep Island, and lies about 1 mile south-eastward of it.

Sir John Hayes Island, about 7 miles southward of Sargent Island, is 1,596 feet high, and Fletcher Island, 840 feet high, is about 1 mile southward of its southern end.

Great Western Torres Islands is the western group of Mergui Archipelago, the two largest, 1,378 and 1,413 feet high, being separated by a channel, which is 200 yards broad at its southeastern end, and about 1,200 yards at its northwestern, with general depths of 15 to 22 fathoms, but at its narrowest part, where the fringing reef on either shore reduces the passage to about 50 yards, it shoals to 7 fathoms over coral and sand.

Halfway through the channel a deep cove, the sides of which are fringed by coral, extends about 600 yards into the southwestern island, with depths decreasing from 12 fathoms off its entrance to 7 fathoms near the head, which is filled with sand.

Anchorage for vessels of too great length to moor in the cove may be obtained in depths of from 15 to 18 fathoms off the entrance, but the holding ground is indifferent and the position open to the swell; a short vessel requiring repair or fresh water can moor inside.

Directions.—Enter the northwest end of the channel between the islands, and with the northeastern Little Torres Islet showing through the southeast entrance, bearing 131° , and when the cove opens anchor as convenient.

Tides.—It is high water, full and change, in this cove at 10h. 20m. (approximate).

Little Torres Islands are a group of four islets, the northeastern islet 228, and the highest 304 feet high; the second islet from the southward appears double, and has a needle-shaped rock off it. The positions of the three southern islets are doubtful, and they should not be approached within 3 miles.

Nearchus Passage is between Great Western Torres and Fletcher Islands, and the following is the track recommended to Christmas Island:

From 2 miles northward of Great Western Torres Islands steer to pass $1\frac{1}{4}$ miles southward of Fletcher Island, and then about 68° , passing 2 miles southward of Courts Island, the summit of which, from this direction, appears as a volcanic cone, but the peak on the northern part of Bentinck Island is not conspicuous. From southward of Courts Island steer about 51° for Christmas Island, passing 3 miles northward of Warning Rock.

Lunka Rock, which dries 6 feet at low water, lies $5\frac{1}{4}$ miles, 240° , from the 1,180-foot summit of Courts Island. There is deep water all around.

Nearchus Rock, covered at high water, is situated 13 miles east-southeastward of Fletcher Island, and $8\frac{1}{2}$ miles from the west coast of Bentinck Island; about $1\frac{1}{2}$ miles off it are depths of from 31 to 35 fathoms.

Black Rock, which is isolated and visible from a distance of 8 miles, lies about $15\frac{1}{2}$ miles southeastward of the southern Little Torres Island.

Bentinck Island (Bazangu), 15 miles in length in a north-northwest and south-southeast direction, about $4\frac{1}{2}$ miles in greatest width and of irregular shape, is hilly, with several high summits, the most conspicuous, 1,012 feet high, being near its northern end; it appears like a horn on northeasterly or southwesterly bearings.

The northeastern arm of Bentinck Island is really a separate island, having a narrow channel with a depth of about 2 fathoms separating it from the main island and leading through into the northern bay, which has been only partly examined. The west coast of the island is steep and iron bound, with several islets off it; but on the east coast, which is much indented, there is smooth water and good anchorage, especially between the Passage Islands.

Daphne Rock, awash at low water, lies about $\frac{1}{2}$ mile off the east coast at $4\frac{1}{2}$ miles northward of Bluff Point, the southeastern extreme of the island.

Several rocks, one of which is perforated, lie off the southern end of Bentinck Island; the southern rock is about 10 feet high and lies $2\frac{1}{2}$ miles southwestward of Bluff Point.

West Passage Island, bold, wooded, and situated about 2 miles eastward of the northeastern part of Bentinck Island, is 445 feet high and steep to on its eastern, but foul on its western, side; it marks the western side of the channel leading southward from Christmas Island.

Warning Rock dries at half tide, and lies $4\frac{3}{4}$ miles north-northwestward of the eastern point of West Passage Island.

Rock.—A rock, 15 feet high, lies $3\frac{1}{2}$ miles northwestward of the eastern point of West Passage Island.

Peterson Rock dries 6 feet at low water, spring tides, and is situated $1\frac{1}{2}$ miles west-northwestward of the eastern point of West Passage Island.

Rock.—A sunken rock has been reported about 1 mile northward of the eastern end of West Passage Island, but its position is doubtful.

Elephant Island, 2 miles eastward of West Passage Island and 141 feet high, appears flat topped from a distance but is really of very peculiar shape; it marks the eastern side of the channel abreast West Passage Island.

Cap and Feathers, a single rock, 34 feet high, lies $\frac{1}{2}$ mile northwestward of Elephant Island, and must be given a berth of at least 600 yards.

The general depths in the channel between West Passage and Elephant Islands are from 3 to $3\frac{1}{2}$ fathoms.

South Passage Island, about $3\frac{1}{2}$ miles southward of West Passage Island, is 364 feet high, bold, and wooded.

Reef.—A reef, uncovering at low water, was reported in 1914 $\frac{1}{2}$ mile, 12° , from the northeast extreme of South Passage Island.

Morrison Bay is formed by Sellore Island to the eastward, Domal, Money, Trotter, and Parker Islands to the westward, and Kisseraing Island to the southward. The deepest water is on the western side, where there are depths of 10 fathoms. It is full of islands and rocks, particularly to the eastward. Celerity Passage is entered at its southwest corner, and there is a deep channel between Sellore and Julian Islands.

Domal Island is mountainous, densely wooded, 23 miles in length by 4 miles in width, and attains a height of 2,236 feet in Charles Ross Hill, nearly in its center. Its western shores, together with those of Money, Trotter, and Parker Islands to the northward, have not been surveyed.

Parker Island, the northern one, is densely wooded and 4 miles in length. Off its northeastern point are three small islands, Edmond, 210 feet high; Wedge, 55 feet high; and Wilmot, 195 feet high.

Pirie Island is conical, densely wooded, and 430 feet high. Tree Island lies about $\frac{1}{2}$ mile westward of it. Shoal water extends about $\frac{1}{2}$ mile northwestward of Tree Island.

Star Island, densely wooded and 370 feet high, lies 1 mile south-southwestward of Pirie Island; it is the northern and eastern of a group of five islands lying off the southeastern point of Parker Island.

Reef Island, the southern one, is 165 feet high and lies about $\frac{1}{4}$ mile off the northeastern end of Trotter Island; a small mangrove islet lies about $\frac{1}{4}$ mile eastward of it.

Trotter Island is about $4\frac{1}{2}$ miles long, 1,070 feet high, densely wooded and very irregular in shape; there is deep water close to its eastern point.

Whaleback Rock, 5 feet high, lies 1 mile northward of the eastern point of Trotter Island; there are shoal patches north-northwest and southwest of it, but deep water to the eastward.

Heath Rock, with 5 feet of water, lies 1.2 miles, 49° , from Whaleback Rock, and can generally be recognized by the eddies over it.

Forfar Rock, a patch of rocky ground 200 yards in length, lies $1\frac{1}{2}$ miles eastward of Whaleback Rock; two heads of it are 4 or 5 feet above high water. There are depths of 5 to 10 fathoms all around it.

Square Rock, 15 feet high, is small and lies 2 miles, 108° , from the eastern point of Trotter Island, and Quoin Rock, 30 feet high, lies $\frac{1}{4}$ mile 192° from it; there is a small growth of jungle on both.

Money Island is about $2\frac{1}{2}$ miles long and 1,182 feet high near the southern end. It is densely wooded, and its eastern shore forms several small bays fringed with mangroves. Between Money and Domal Islands there is a small wooded island nearly in the middle of the channel.

Jack Island, 225 feet high, lies $\frac{1}{2}$ mile off the northeastern side of Money Island, and is sparsely wooded. There is a fishing village on the northern side.

Una Island, to the northward, is 75 feet high and separated from Jack Island by a channel 400 yards wide. None of the channels between these islands should be used, as the tides are strong and irregular.

Celerity Passage, a narrow channel, $4\frac{1}{2}$ miles long, with depths of from $1\frac{1}{4}$ to $3\frac{1}{4}$ fathoms, lies between Domal Island and the extensive flats westward of Kisseraing Island; it is very winding, and only from 200 to 400 yards wide. Vessels should only use it on the last of the flood, but the tides are not strong. Approaching from the northward, steer to pass close eastward of Una and Jack Islands, about 400 yards from the latter, then work over to the eastward of Money Island, where there is the deepest water. When the eastern point of Money Island is passed, steer southward for 1 mile, then 158° , keeping Pagoda Point well open of the rock 1,200 yards northward of it; when the north point of Domal Island bears 91° steer for Pagoda Point, passing it at a distance of 200 yards, then keep in mid-channel between Leslies Garden to the eastward and two rocky points of Domal Island to the westward. After this the channel is marked by beacons, red to eastward and white to westward. After passing white beacon No. 3, surmounted by a cone, steer south

till deep water is reached. The channel is well marked by discoloration.

Donnelly Reef, 2 miles off the southwestern side of Sellore Island, is about 400 yards in extent, and uncovers at half tide; shoal water extends about $1\frac{1}{2}$ miles from it in a north-northwest direction, and about 100 yards to the southward. Other patches lie from 2 to 3 miles westward of Sellore Island.

Donnelly Island, 155 feet high, lies $1\frac{1}{2}$ miles off the southwestern point of Sellore, is well wooded, and marks the northern side of the channel between Julian and Kennedy Islands.

Wright Island, small and well wooded, lies 600 yards westward of the southwestern point of Sellore; there is deep water between it and Donnelly Island, but the tides are irregular and strong.

Julian Island, lying off the north end of Kisseraing, is 3 miles long north and south, and 2 miles wide, irregular in shape, and 440 feet high, the highest part being on the western side. An extensive mud bank extends off the western coast for about $3\frac{1}{2}$ miles to the northwestward. There is a village near the south point of the island.

Sidney Island, small, thickly wooded, and 70 feet high, lies $\frac{1}{2}$ mile off the northwestern point of Julian Island, and marks the south entrance point of the channel.

Twin Rocks, 30 feet high, lie 1,600 yards 147° from Donnelly Island, and 800 yards southward of them lie the Bird Rocks, white, and 4 feet high. There is deep water close to the latter.

Kennedy Island, 1 mile eastward of Julian Island, 570 feet high, and densely wooded, is $1\frac{1}{2}$ miles long, north and south, and 1,600 yards wide. Numerous islets and rocks lie between it and Sellore Island, and a 5-fathom patch lies between it and Julian Island.

Tucker Island, eastward of Kennedy and only separated from it by a channel 200 yards wide, is densely wooded, and has two summits 760 and 730 feet high.

Marble Islands (Elephant or Ye-eihet thaik), a group of two large and four smaller islands, lie from $1\frac{1}{2}$ to 2 miles off the southeastern end of Domal. The largest and highest, 1,038 feet, is near the south end of the group. The islands are practically bare of trees, rocky, precipitous, and steep-to. The deepest water is between them and Domal Island.

High Peaked Island, westward of the southwestern point of Domal Island, is 956 feet high, and appears of conical shape from the northward and northwestward. Off the northern end of High Peaked Island is Second Observation Islet, 272 feet high, and cliffy, and two rocks, the northern of which, 44 feet high, is named Fly Islet.

Fly Rock, $2\frac{1}{2}$ miles northwestward of Fly Islet, is a pinnacle of rock covered with coral, awash at low water, spring tides, and only a few yards in extent; it is steep-to on all sides, and can not be seen at ordinary low water.

Bushby (Buza) Island is bold, with many wooded summits, 400 to 1,028 feet high, and abounds with wild pigs. Its north coast is indented, and there is a village on the shore of one of its bays. Cone Islet, 200 feet high, lies 1 mile off its western coast.

Anchorage in a depth of 8 fathoms may be obtained just outside a line joining the points of a small sandy cove at the northwest point of the island, and here there is a good watering place.

Five Sisters is a group consisting of five small islands and about 15 rocks of various sizes, mostly bare, and probably uninhabited. Some of the rocks and dangers on the eastern side of the group are not easily seen at night, one of them being a reef only 10 feet high.

A group of rocks above water, one of which is 50 feet high, lies about $2\frac{1}{2}$ miles south-southeastward of Charlotte Island, the southern of Five Sisters.

Kisseraing (Kitthareng) Island, eastward of Domal Island, is 18 miles long in a north and south direction, 10 miles broad, and considered one of the most fertile of the Mergui Archipelago.

Sidney Island, small, wooded, brown in appearance, and 125 feet high, lies $\frac{1}{2}$ mile off the southwestern point of Kisseraing. Rocky ledges extend off its northeastern and southwestern points for a distance of about 400 yards.

Lalla Rookh Island, 550 yards long north and south, 200 yards wide, and 106 feet high, lies $1\frac{1}{2}$ miles westward of Mawyt Point. It is well wooded, and has a conspicuous dark tree at its northern end. It is the southern of a small group of islets in the bay at the southwestern end of Kisseraing—Pitt Islet, 93 feet; Tango Islet, 105 feet; and Pillam Islet, 80 feet high. All these islets are thickly wooded, and fringed with reef; inside of them, and between them and Kisseraing, the water is foul with numerous patches that dry.

Steep Point, on the eastern side of Kisseraing Island, is situated about 6 miles north of Mawyt Point, the south extreme.

Bhadra Reef fronts the shore for about 3 miles southward of Steep Point, extending about $1\frac{1}{2}$ miles from it.

On the outer part of this reef, about $1\frac{1}{2}$ miles south of Steep Point, is situated a rock on which the steamship *Bhadra* struck in 1912 when drawing 8 feet.

Whale Bay, between the southeastern side of Kisseraing Island and the mainland, is a spacious anchorage, the approach to which is from the southwest. There is good anchorage in depths of from 6 to 10 fathoms in the eastern part of Whale Bay, but the bay and all its vicinity have been only partially examined, and should be

navigated with caution. There is a police station at Cheding on the southeastern side of the bay.

Campbell Rock.—Campbell Rock, which just uncovers at low water, lies 3.2 miles, 44° , from Mawyut Point, the south point of Kisseraing Island. The rock, which has two pinnacles, and has deep water to the eastward, appears to be of small extent.

Coast.—The coast from Lenga River trends to the southward and is fringed with mangroves nearly the whole way, and is intercepted with creeks, the largest being Yengan Myit, about 12 miles, and Bokpyin Creek. There are numerous villages, the largest being Cheding.

Wet Kuin, or Pig Island, 410 feet high, off the eastern shore of Whale Bay, is well wooded; there is no channel between it and the mainland.

Sail Rock, $\frac{1}{2}$ mile southwestward of Wet Kuin, is 52 feet high and of whitish appearance.

Bokpyin Creek, about 7 miles south of Cheding, is a small stream flowing between mudbanks, nearly dry at low water; it is marked by beacons as far as the village, but is only navigable by boats. The village on the south side of the creek, about 3 miles from the entrance, is mostly built on piles, and has about 500 inhabitants. The district police officer's house, on a hill above the village, is conspicuous.

Communication.—A British India Steam Navigation Co.'s steamer calls here fortnightly.

Warrington Reef, an isolated patch of small extent, with a least depth of 5 feet, lies about $2\frac{1}{4}$ miles westward of Cheding.

Silver Island, 215 feet high, lies 4.8 miles westward of Bokpyin Village, is small, well wooded, and a good landmark for making Bokpyin. Anchorage for small vessels can be obtained in 4 fathoms a mile southward of the island.

A shoal extends $\frac{1}{2}$ mile off the northeastern side of the island, with small rocky patches drying at half tide.

Boat Rock, 1,600 yards northward of Silver Island, is 50 feet high; shoal water extends 800 yards north-northeastward of the rock.

Bhadra Rock, a patch of small extent, drying 3 feet, with 4 or 5 fathoms all round it, lies $1\frac{1}{2}$ miles westward from Boat Rock.

Elephant Rock, conspicuous and 158 feet high, $4\frac{1}{2}$ miles southwestward from Silver Island, is the northern islet of a group off the southwestern shore of Bokpyin; vessels should not approach the eastern side of these islets, as there are many rocks and reefs.

Druid Rocks, three conical rocks, 70 feet high, lie $1\frac{1}{2}$ miles southward of Elephant Rock; foul ground extends $1\frac{1}{2}$ miles northeastward and 1,600 yards eastward of the rocks.

Bedford Islets, three small islets $3\frac{1}{2}$ miles 208° from Elephant Rock, are well wooded, and at a distance appear as one; the southern is the largest, and 250 feet high. There are no dangers to the north and west, but foul ground extends $1\frac{1}{2}$ miles eastward.

Mawyut Point, the south extreme of Kisseraing, is steep to the southward and eastward, but a large bay with foul ground lies to the westward.

Vera Island, about $2\frac{1}{4}$ miles southward of Mawyut Point, is 295 feet high, well wooded, with a conspicuous tree on its summit. The channel between it and the point has depths of from $6\frac{1}{2}$ to 27 fathoms. There are numerous tide rips in the channel.

Vera shoal, of $6\frac{1}{2}$ fathoms, lies nearly in the middle of the channel.

Paye Island is $3\frac{1}{2}$ miles long in a north and south direction and 3 miles in a northeast and southwest direction, and 681 feet high near the south end. A reef extends about $\frac{1}{2}$ mile off the northeast side; there is no anchorage.

A shoal of $1\frac{1}{4}$ fathoms extends about 1 mile off the southeastern point of the island.

The channel between Paye and Vera Islands is foul.

Robert Island, southwestward of Paye Island, from which it is separated by a narrow channel, is 230 feet high, and densely wooded.

Alice Island, small and 104 feet high, lies nearly midway between Paye and Sir C. Malcolm Islands; vessels should pass between Alice and the latter island.

Shoal water extends $\frac{1}{4}$ mile off the north and east sides of Alice Island, and about 1 mile off its southwestern point.

Sir C. Malcolm Island is 4 miles long and 1 mile wide; the center of the island is low, the summit, 901 feet high, being near the south end. It is well wooded, and fresh water has been found on its northeastern side. Shoal water lies off its western side, extending 2 miles off the southern end, with less than 3 fathoms, and numerous dry patches. Several dry patches also lie within $1\frac{1}{4}$ miles southward of the island.

Cheding Flats extend from the north and east coast of Sir C. Malcolm Island right across to the mainland just south of Yengan Myit; there is a badly defined channel across the middle of them, with a width of $1\frac{1}{2}$ miles, but only 7 feet of water. Vessels crossing should keep the north end of Lalla Rookh Island open of the south end of Vera Island bearing 320° until the north end of Sir C. Malcolm Island bears 251° , when alter course to 203° until deep water is reached.

Barn Island, 374 feet high, lies $4\frac{1}{2}$ miles westward of Sir C. Malcolm Island, is thickly wooded, and clear of dangers.

Westward of the channel between Sir C. Malcolm and Paye Islands are four small islands, Ruby, 140 feet; Fink, 270 feet; Law-

rence, 265 feet; and Molly, 140 feet high. Vessels should not use the channels between them on account of the tide rips and varying currents.

Coast.—Karathuri is situated about 21 miles southward of Bokpyin Creek, and between the coast is much intersected by creeks and streams, and backed by hills. Karathuri Village is entirely inhabited by Chinese, who wash tin, and a village named Kyauk-Kyi-Chaungwhese (not charted), to the northward of Karathuri, is similarly inhabited.

Chauntanaung Village, about 4 miles southward of Karathuri, is deserted.

Son and Father, two barren, rocky islets, 335 feet and 596 feet high, respectively, lie close together in a north and south direction from each other; Son Islet is situated $7\frac{1}{2}$ miles south-southeastward of Charlotte Island, the southern of the Five Sisters. Rocks above water lie about a mile north-northwestward of Son Islet.

Forrest Passage, between Father Islet and Sullivans Island, is nearly 13 miles wide. The flood tidal stream sets eastward and the ebb westward at a rate of about $2\frac{1}{4}$ knots at springs.

Clara (Awi) Island, westward of Sullivans Island, is about $6\frac{1}{4}$ miles in extent in a northeast and southwest direction, and tapers to a point at its southwest end; it has two peaks, the northern and higher of which is 1,753 feet high, and the southern peak is sharp.

North Sentinel Islet, with a rock on its western side, lies about $1\frac{1}{2}$ miles northeastward of the northeastern point of Clara Island.

South Sentinel Islet is high and lies about 1 mile southward of the southwest point of Clara Island.

Forrest Strait.—**High (Tsing) Island**, with a double peak, 1,392 feet high, lies about 5 miles east-northeastward of the northeastern part of Sullivans Island. Overfalls and tide dips are numerous northward of the island.

A rocky ledge dries out 400 yards from the large sandy beach on the eastern side of High Island, and northward of this there is a cove where fresh water can be obtained; but a kedge is required for anchoring close in, as the depth is over 15 fathoms.

The track lies 2 miles westward of the island, where there are overfalls and eddies, probably caused by an irregular bottom, and passes through discolored patches.

Sullivans or Lampi Island, 19 miles long in a north-northwest and south-southeast direction, with an arm extending 9 miles southwestward from its northern point, is of very irregular shape, and about $2\frac{1}{2}$ miles in average width. Its northern point is about $12\frac{1}{4}$ miles south-southeastward of Father Islet.

At the north end of Sullivans Island, but close to it, are several small islands; Two Hill Island, 548 feet, and Olive Island, 353 feet

high, with the exception of a rock with less than 1 fathom water over it northwestward of the latter, appear to have deep water off them, but Dolphin Islands, which are 3 miles farther south and 169 feet to 226 feet high, with conspicuous trees upon them, have a bank extending $1\frac{1}{4}$ miles eastward of the southern island.

The Foreland, on the eastern side of Sullivan's Island, and about 15 miles from its northern point, has a low white cliff on it which shows up in the morning sun. Bold Promontory, $2\frac{1}{2}$ miles southward of the Foreland, is not so conspicuous.

Water.—An excellent stream of fresh water flows into the sea near this anchorage at all times of the year; the watering place is known by a large white rock, which fronts it.

Half Moon Reef, lying 3 miles northward of the northern extreme of the Foreland, and $1\frac{1}{4}$ miles offshore, dries 2 feet at low water, spring tides, and is about 400 yards in extent. Olive Island summit, open eastward of the Dolphins, bearing about 321° , leads northeastward of Half Moon Reef; and Bold Promontory, open eastward of the Foreland, bearing 190° , leads eastward of it.

Eyles (Naza) Island, about 2 miles in extent and 774 feet high, and Steep Island, 426 feet, lie off the southern end of Sullivan's Island; and $1\frac{1}{4}$ miles eastward of Steep Island is Steep Shoal, a narrow, rocky shoal, with a depth of 5 feet over it at low water; High Island summit, open eastward of the Foreland, bearing 359° , leads eastward of the shoal.

Anchorage.—A pearl bank of some extent has been reported off the western side of the island, and there are also several islands sheltering an anchorage with depths of from 4 to 6 fathoms eastward of the southern island, but it has only been partially examined.

The Gregorys, a group of five low level tree islands on flat, rocky bases covered with sand, lie eastward and southeastward of the southern part of Sullivan's Island and in the middle of Forest Strait; the group is uninhabited, but visited by woodcutters, and the Nicobar Pigeon, the flying fox, the monitor lizard, and tree crabs are found.

Crichton or Bogwo, the northernmost of the group, about $3\frac{1}{4}$ miles east-southeast of Bold Promontory, is a mere wooded cay, with shoal water extending $1\frac{1}{4}$ miles northward of it, and terminating in Marble Patch, on which is a depth of 4 feet over coral.

Boyut, 180 feet high, the southern Gregory, has a shoal ridge extending southwestward of it, and it should not be approached from any direction within $1\frac{1}{4}$ miles. Rocky ledges project from all the islands of this group, and the passages between the islands are foul.

Tides.—It is high water, full and change, at the Gregorys at 10h. 20m.; springs rise 14 feet; neaps rise 10 feet. In winter night tides

are higher than day tides. In summer the mean level of the water is higher than in winter.

Tidal streams.—Near High Island the flood stream sets eastward and the ebb westward.

In the channels on either side of the Gregory Group the flood sets north-northeastward, and the ebb south-southwestward.

Kurrachee Rock, nearly 2 miles east-southeastward of the southern extreme of the largest Gregory Island, dries 5 feet at springs; to clear it on its eastern side keep in depths of less than 10 fathoms, and the northern and larger Turret Island (Kasaingle), 341 feet, bearing 166°, with the smaller island shut in by it, leads eastward of the rock.

The eastern side of **Forrest Strait** is formed by the main land of Tenasserim, which, although high at some distance from the sea, is low near the shore and without any conspicuous mark; Boyce Hill, 806 feet high and 1½ miles inland, being the only hill near the sea. The coast is fronted by a mud bank, with several rocks showing at low water inshore, and off the northern end of Boyce Headland are several small islets.

Canister Rock, the northernmost of these islets, is 87 feet high, small, steep, and situated 12½ miles south-southeastward of High Island. A rock, which dries 4 feet at low water, spring tides, lies ¼ mile northward of Canister Rock.

Campbell Reef, a flat, stony reef that covers at high water, is 400 yards long by 300 yards wide, and lies 3¼ miles southward of Canister Rock. Caution is required when proceeding southward in the vicinity of this reef, as there are depths of 6 fathoms within 1 mile of it.

Boyce Shoal, said to have a depth of 2 fathoms over it at low water, with 4 to 8 fathoms around, and to lie about 2¾ miles south-eastward of Crichton Island, was not found when the strait was surveyed in 1886; its existence is doubtful.

Directions.—**Forrest Strait** is used by all steamers and native vessels trading through the archipelago, there being plenty of water and good shelter from westerly winds. In navigating the strait it is advisable to take bearings to summits, and not to extremes of land which may be affected by distance, mirage, and new growth of foliage. Although the strait (in the track recommended) is navigated by night with local knowledge, a stranger should not do so, owing to the difficulty of the channel between Marble Patch and Campbell Reef.

Continue the 153° course, which was shaped between Bushby Island and the Five Sisters (p. 423), allowing for set, to a position 3½ miles southwestward of Canister Rock, and then steer 165°

for Turret Island, a bold precipitous rock 341 feet high, which appears in clear weather to stand out from the land like a square block, which course leads in midchannel between the Gregory Group and the mainland, the depths gradually shoaling to 5 and $3\frac{1}{2}$ fathoms at low water.

The narrowest part of this channel is between the rocks off Red Point (which is not red) and Kurrachee Rock, where it is about 4 miles wide. When the southern end of the largest Gregory Island bears 290° , steer 203° for $4\frac{1}{2}$ miles into deep water, and then 176° to pass from 2 to 3 miles eastward of the Five Islands, when steer about 193° to clear the extensive sand and mud flat lying off Pakchan River entrance.

The channel westward of the Gregory Group, although deeper, has irregular soundings, and is impracticable by night; it is not recommended.

Anchorage is good anywhere between High Island and Turret Island.

Outer Islands.—**North and South Twin**, the westernmost of the islands of this part of Mergui Archipelago, are of small dimensions, and have not been examined.

Great Swinton Islands, close together, stretch about 7 miles in an east-northeast and west-southwest direction, the western island being nearly 20 miles south from the southern peak of Clara Island. The following small islets lie north-northeastward of the westernmost of the Great Swinton Islands: Islet with a rock westward of it 4 miles; Red Islet, 10 miles; Brown Islet, $13\frac{1}{2}$ miles; and Ninepins Rocks, 16 miles, the latter rocks being 3 miles southward of the islets off the southern point of Blunt Island.

Loughborough Passage, between Great Swinton Islands and Loughborough (Salan) Island, is about $2\frac{1}{2}$ miles wide, and on the northeastern side of Loughborough Island and about $\frac{3}{4}$ mile offshore, a few soundings of 17 to 19 fathoms, over clay, have been obtained. Hayward Island, with rocks extending northeastward of it, lies about $\frac{1}{2}$ mile northeastward of the eastern point of Loughborough Island.

Anchorage.—There is good anchorage between Loughborough Island and Richards Island, eastward of it, in depths of from 8 to 15 fathoms, over mud, with 3 fathoms close to either shore.

Pollock Reef.—A rock above water and Pollock Reef, a sunken reef, lie in mid-channel between Loughborough and Great Swinton Islands, Pollock Reef being about $2\frac{1}{2}$ miles of the northeastern side of the former island and almost exactly in mid-channel. The passage between Loughborough and Great Swinton Islands should therefore not be used for navigation.

O'Connor, Saul, and Skinner Islands, lying from 1 mile to 2 miles eastward of Richards Island, are of irregular form, each being about $\frac{1}{2}$ mile in diameter, and it is said that there are outlying rocks around them. If passing between them and Richards Island keep nearer to Richards Island.

Cavern (Tai naine) Island.—Several islands lie southeastward of Loughborough Island, the largest being Cavern Island, on the southern part of which are several caverns where edible nests of the swift are procurable; it is distant about 5 miles from Loughborough Island. The central part of Cavern Island is reported to be very narrow.

St. Matthews Island, the northeast extreme of which is about 15 miles from Point Victoria on the north side of the entrance to Pakchan River, is 16 miles in length in a northeast and southwest direction, 6 miles in greatest breadth, and nearly 3,000 feet high in its central part. Tracks of large animals and elk have been seen on the shore of Hastings Harbor, and wild hogs and pigeons are plentiful, but the jungle is dense; some fine straight timber grows here, and fresh water may be obtained, except in unusually dry seasons.

Russell Island, the center of which lies about $11\frac{1}{2}$ miles northeastward of the northern point of St. Matthews Island, should not be approached, as sunken rocks are said to exist northwestward and southward of it. The channel between Russell and St. Lukes Islands appears to be navigable, but rocks are charted on its northern side.

Hastings Harbor, formed by St. Lukes and Hastings Islands and the north coast of St. Matthews Island, is about 5 miles in extent, and affords excellent and sheltered anchorage; it has two entrances, one northwestward of Hastings Island, the other southwestward of it.

A rock patch, dry at low water, spring tides, with 9 to 10 fathoms close-to, lies on the northern side of the southern entrance, 1 mile east-southeastward of South Point, Hastings Island; and a rock, about 40 yards in extent, with 2 fathoms least water over it, and 7 fathoms close-to, lies 1,800 yards south-southwestward of the same point.

There are no known rocks in the northern entrance, but several islands lie in its approach, with apparently deep water between them; caution is necessary in the vicinity as it has not been surveyed and the water is sometimes muddy when shoals are not seen from aloft.

Anchorage.—Two anchorages are charted, one in a depth of about 11 fathoms in the northern entrance, with Northwest Point, Hastings Island bearing 77° , distant 1.4 miles; the other in the

southern part of the harbor, in about $6\frac{1}{2}$ fathoms water, with South Point, Hastings Island, bearing 92° , distant about $2\frac{1}{4}$ miles; the bottom in the harbor is mud.

Tides.—It is high water, full and change, in Hastings Harbor at 10h. 40m.; springs rise 14 feet. The rate of the tidal streams at springs is about 1 knot an hour.

Fish Harbor, a bight in the northeastern side of St. Matthews Island, and about $1\frac{1}{2}$ miles southward of the southern entrance to Hastings Harbor, is available for vessels of about 9 feet draft. A small white rock or islet, with deep water around, lies about 1 mile off the entrance.

Outlying islands.—**St. Andrews Group**, situated between 9 and 21 miles northwestward of St. Matthews Island, are numerous, with six principal islands named after the letters A to F.

Horsburgh or E Island, the northwesternmost of this group and about 20 miles northwestward of St. Matthew's Island, is visible from a distance of about 20 miles.

Cockburn Islets, three in number and lying in nearly a north and south direction, are situated about $5\frac{1}{4}$ miles eastward of Horsburgh Island.

Parsons Rock, a compact group of pinnacles drying 3 to 4 feet at low water, is situated nearly 2 miles eastward of the northern Cockburn Islet.

Investigator Channel, which passes between Cavern Island on the north and St. Andrew's Group on the south, has a least width of nearly 6 miles, and appears to be clear; it is a good channel for vessels from the westward bound to Hastings Harbor.

Banks.—Three banks surrounded by deep water, but of which little is known, lie westward of Investigator Channel: Heckford Bank, with a depth of 7 fathoms over it, situated in latitude $10^\circ 21'$ north, longitude $97^\circ 11'$ east; Coral Bank, with a depth of 11 fathoms, situated about 8 miles southward; and Roe Bank, with 8 fathoms over it, 19 miles southwestward of Heckford Bank.

Aladdin Islands, southwestward of St. Matthews Island, is a scattered group, about 19 miles in length in a northwest and south-east direction, by about 15 miles in breadth; some of the islands are high and bold.

Western Rocky Island, the western of the group, is less than $\frac{1}{2}$ mile in extent, but of considerable height, being visible from a distance of about 12 miles.

North Rocky Island lies about $5\frac{1}{2}$ miles east-northeastward of Western Rocky Island.

Davis Island, one of the largest of the cluster, situated 4 miles from the southwestern end of St. Matthew's, is nearly 4 miles in diameter, and should be visible from a distance of about 21 miles.

Dunkin Island, $2\frac{1}{2}$ miles eastward of Davis Island, is also high; $\frac{1}{2}$ mile from its eastern side the depths are from 10 to 21 fathoms.

Haycock, an isolated rock, lies $10\frac{1}{2}$ miles south-southeastward of Western Rocky Island, with depths between of from 25 to 32 fathoms.

Christie Island, 9 miles south-southwestward of the southwestern point of Davis Island and the southern of Aladdin Group, is of irregular form, and some rocks above and below water lie eastward and southward of its southern end.

Auriol, about 6 miles eastward of Christie Island and the southeastern island of the group, is probably bold, there being 16 fathoms water at a short distance from its eastern side.

Chance Island, situated 10 miles south-southwestward of Christie Island, is of irregular form, 5 miles in extent in a north and south direction, and 3 miles greatest breadth; its peak is visible from a distance of about 30 miles in clear weather. There are several rocky islets in its vicinity, and some rocks above water are situated off its southeastern side, and the island should not be approached, as it has not been examined.

Torilla Island is situated $\frac{3}{4}$ mile south-southwestward of the south extreme of Chance Island.

A rock has been reported to lie about midway between Christie and Chance Islands, about 5 miles north-northeastward of the latter, but its existence is doubtful.

Richelieu Rock, awash at low water, is supposed to lie nearly midway between Chance Island and the coast, about $12\frac{1}{2}$ miles east-southeastward of that island, but the position is doubtful. The rock is said to be smooth and oval in shape, about 100 feet long, and in appearance like a vessel turned bottom up.

Middle Island, 18 miles south-southwestward of the south point of Chance Island, is $1\frac{1}{2}$ miles in length in a north and south direction, and high enough to be seen from a distance of 25 miles.

Perforated Island, about 400 feet high, which has a hole through it, lies 14 miles southward of Middle Island. The depth at 1 mile eastward of it is 46 fathoms.

Sayer Islands consist of nine islands, in three groups, extending in a north and south direction over a distance of 12 miles; they are densely wooded and practically steep-to.

North Island, the northern of the group and situated $11\frac{1}{2}$ miles south-southwestward of Perforated Island, is 334 feet high, and in the channel between it and Great Sayer Island is a depth of 23 fathoms.

Great Sayer Island or Pulo Tajah, 800 yards southward of North Island, is 2 miles in length in a north and south direction, nearly 1 mile in greatest width, and rises at the northern part to a

height of 802 feet. At the northeastern point is a small cove, with 7 fathoms water in it.

Channel Rocks, from 15 to 20 feet high, lie $\frac{1}{2}$ mile southwestward of Great Sayer Island, and are steep-to.

Center Islands are four in number; the northern, conical in shape and 392 feet high, is about $1\frac{1}{2}$ miles southward of Channel Rocks, with depths of from 34 to 44 fathoms in the channel between; the southern island is 447 feet high, and two islets nearly connected by a reef lie off its northeastern point, with a depth of 8 fathoms in the channel between.

Payan Island, the northern of the southern group, 151 feet high and conical in shape, lies $2\frac{1}{2}$ miles south-southeastward of the southern Center Island.

Taku Rocks, about $\frac{1}{2}$ mile southeastward of Payan Island, are three rocky heads which cover at high-water spring tides, and a few detached rocks, all being steep-to.

Sangasiap Island, 1 mile southwestward of Payan Island, is 428 feet high, 1 mile long in a northwest and southeast direction, 500 yards broad at its southeastern extreme, and narrows gradually to Andrew Point, its northwestern extreme, which is broken, cliffy, and 59 feet high.

South Island, $\frac{1}{2}$ mile southward of Sangasiap Island, has a double summit, the peaks being 385 feet and 368 feet high. The sand beach on the northeastern side is fronted by a coral reef extending 200 yards offshore. The observation spot at the eastern end of the beach is in the position given.

Tides.—It is high water, full and change, at these islands at 10h. 0m. (approximately); springs rise about 8 feet.

Tidal streams.—In the channel between Sangasiap and South Island the flood stream sets eastward and the ebb westward, while outside the streams appear to set northeastward and southwestward.

Pakchan River rises in about latitude $10^{\circ} 50'$ north, longitude $99^{\circ} 0'$ east, and is about 80 miles in length; it is densely wooded on both sides, and numerous streams flow into it, the principal of these are Maliwum, on the British side, and Klong Bang Pra, Klong Raun, and Klong Lam Lieng on the Siamese side.

Boundary.—Pakchan River separates the territories of British Burma and Siam.

Point Victoria, the northwest entrance point to Pakchan River and the southern extreme of the Maliwun Hills, is high, bold, and steep-to.

Radio station.—A radio station, open to the general public at all times, is established on this point.

The call letters are V. T. V.

Storm and weather signals.—Storm and weather signals are furnished to vessels by radio on demand.

Light.—A fixed white light is exhibited 162 feet above the sea from an iron mast 76 feet high on Point Victoria, visible 6 miles.

Approach—Banks.—Westward of the northern entrance point to Pakchan River is the southern side of an extensive triangular-shaped bank, the western edges of which trends in a south-southwest direction from Round Woody Island, situated $13\frac{1}{2}$ miles northward of Point Victoria, the northern entrance point, for a distance of 17 miles, at which position the extreme of the bank is $11\frac{1}{2}$ miles west-southwest of Point Victoria; most of this bank has depths of less than 3 fathoms, and there is only $\frac{1}{2}$ fathom near its center, with rocks on its western edge. On the southern edge of this bank are Long, North, and other islands.

Southward of the above bank and separated from it by a channel about 3 miles wide at its entrance and narrowing to 2 miles when southward of the west end of Long Island, is another large bank, which has not been examined, but is apparently about $1\frac{1}{2}$ miles wide at its extreme, which is $11\frac{1}{2}$ miles southwest of Point Victoria, from which it expands to about 4 miles, having on it Victoria, Mostyn, Festing, Dyke, and other islands.

Law on navigation in Siamese waters.—Every master of a ship shall hoist her colors on entering Siamese waters and shall keep such colors flying during daylight until the ship shall have been boarded by the harbor master.

The master of every vessel entering or going out of any port or river of the Kingdom of Siam shall cast anchor at the guard station of such port or river, report his arrival or departure to the officer of the station and follow the instructions which such officer shall give him.

A copy of the "Law on Navigation in Siamese Waters" shall be handed to the master of every vessel entering a harbor in case he has not already been provided with the same. The price shall be 2 tickals (about 3s.).

Islands—Long, South, and North Islands.—About 3 miles westward of Point Victoria lies a group of islands, of which Long Island, the largest, is about 2 miles in length in an east and west direction, high and wooded. Close to its southeastern point is South Island, round and wooded, and northward of it is North Island, of about the same height.

Victoria Island, large, low, wooded, and somewhat triangular in shape, is 1 mile southward of Point Victoria and apparently on the northeast extreme of the unexamined sand bank. Its northern side is steep-to, with deep water from 400 to 600 yards distant from it.

Mostyn, Festing, and Dyke Islands, southwestward of Victoria Island, are low, wooded, and connected by sand banks. They are named Goh Son by the Siamese and are considered as one island.

Spiteful Rock, a small wooded islet about 180 feet high to the top of the trees, is situated on the southern edge of the unexamined bank, and it is reported that a very narrow bank about $1\frac{1}{2}$ miles in length, with a depth of 1 fathom over it, exists to the southwestward of the islet; also that a rock or obstruction lies about $1\frac{1}{2}$ miles eastward. These dangers are all on the northern side of Bell Passage.

Light.—A flashing white light, visible 18 miles, is exhibited, at an elevation of 180 feet above high water, from a white circular tower, with dome-shaped top, 20 feet high, erected on Spiteful Rock. The top of the tower shows just clear of the trees which cover the island.

Saddle Island (Goh Chang), the largest and highest of the islands along this coast, and situated southward of the unexamined bank, separated from it by Bell Passage, is about 5 miles long in a north and south direction, a little over 2 miles broad, the highest peak being in the middle of the island. Large sand banks extend from the east coast of this island, as well as from the mainland opposite; between them there is a somewhat narrow and shallow channel, difficult to find at high water, but showing at low water from the sand bank drying on both sides.

Some wooded islets lie off the southeast end of Saddle Island, and a sand bank extends off its southwest coast; off the northwest side of the island is Tree Islet, low, rocky, and with small trees on it, and this islet forms the eastern side of the entrance to Bell Passage, the southern side of the passage within, being the north coast of Saddle Island.

Harry Head, the northwest point of Saddle Island, is a high bluff covered with trees, and a rock is reported to be near it. From Harry Head the north coast of the island, trending to the eastward, is low and covered with jungle, as is also the northeastern point, and eastward of the latter small, low, rocky islets, only a few feet above water, are reported, terminating to the eastward in Stainer Rock, which is very low, with a few bushes on it; the existence of the rocks between it and the northeast point is doubtful.

Delisle Island (Goh Piam), 2 miles southwestward of Saddle Island, is high, about $4\frac{1}{2}$ miles long in a north-northeast and opposite direction, and $2\frac{1}{2}$ miles broad; a reef of rocks with from 8 to 10 fathoms water within 1 mile of it, stretches along its west coast. About $\frac{3}{4}$ mile southwestward of the southern point of the island is a rock which dries about 3 feet at low water, spring tides, with 7 to 8 fathoms close-to.

Between this island and the mainland are large sand banks, but there is a channel on the island side. Northward of the island,

between it and Saddle Island, there are depths of 5 to 7 fathoms, but there is a sand bank 800 yards northeastward of its northern point on which the depth is about 2 fathoms at low water.

Eastern shore.—Banlin or Banrim River entrance is eastward of Saddle Island, and from its northern side, on which is Seaward Peak, the east coast, to the entrance to Pakchan River, trends in a north-northeast direction for about 8 miles to the entrance to Renong River, and is bordered by a sand bank which extends for about 1 mile, but nearly midway a spit, with a depth of 3 fathoms over it, extends for 2 miles westward, and has Round Islet on its extremity.

Goh Phi, a small island situated to the northward of the entrance to Renong River, is connected to the mainland at low water and has a sand bank extending southward of it.

Light.—A fixed white light is occasionally exhibited, 48 feet above the sea, from a stone tower on Goh Phi Island,, visible 3 miles.

Buoy.—A buoy marks the extreme of the sand bank extending southward of Goh Phi, but no dependence should be placed on it.

Entrances—Depths.—There are two entrances into Pakchan River, the northern being between the southern edge of the large bank which extends $11\frac{1}{2}$ miles west-southwest from Point Victoria, and has Long Island on this edge, and the unexamined bank which apparently extends a similar distance from Point Victoria in a south-west direction.

This channel, about 2 miles wide at the entrance, has depths of from 4 to 5 fathoms, but within its northern part is obstructed by South Island and an islet which lies about 1 mile southwest of it, and the channel is either close southward of South Island, where the depth is said to be $2\frac{1}{2}$ fathoms, or over a portion of the northern part of the unexamined bank, where the charted depth is 3 fathoms, and between Boundary Island and the islet mentioned as southwest of South Island. After the unexamined bank is crossed the depths increase to from 7 to 10 fathoms between Victoria Island and Point Victoria.

Bell Passage, the southern entrance, is between the south edge of the unexamined bank and the western and northern sides of Saddle Island, with Tree Islet on that side of the channel; it then passes along the southeast sides of Dyke, Festing, and Victoria Islands, and between them and the shoal extending off the mainland.

In this channel the depths are from 6 to 7 fathoms 400 yards westward of Tree Islet, from 4 to 6 fathoms to the northeast end of Saddle Island, and from 4 to 5 fathoms to Dyke Island, decreasing to 3 fathoms when southeast of Victoria Island, and increasing within.

Outer anchorages.—Anchorage may be obtained in depths of from 5 to 6 fathoms, inside the entrance to Bell Passage, and about $1\frac{1}{2}$ miles westward of Harry Head.

There is good anchorage, sheltered from the southwest monsoon, in a similar depth, off the northeast side of Delisle Island.

Inner anchorages.—Anchorages may be obtained off Goh Phi in a depth of $3\frac{1}{4}$ fathoms with that island bearing 91° , distant about 1 mile; or eastward of Victoria Point, where a vessel will be out of the influence of the tidal streams if anchored well in toward the bay on that side.

Victoria Point Harbor.—This small harbor is situated between Victoria Point and Browning Island to the eastward; it affords anchorage in a depth of from 7 to 8 fathoms off the customhouse pier, which extends from the western shore over a space about 300 yards long and 150 yards broad.

A bank with depths of from $2\frac{1}{4}$ to 3 fathoms extends across the southern entrance to this harbor.

Directions—Northern entrance.—Both the chart and the sailing directions must be used with extreme caution, and a vessel from the northward should not stand into a less depth than 8 fathoms toward the bank extending off the mainland to the northward of the entrance.

When approaching the entrance from the northward, Hastings Island should be kept open of both the south entrance point to Hastings Harbor and Bengal Point, bearing about 335° , with a clear vista through that harbor, and used as a stern mark, steering 155° until North Island is just open northward of Long Island, bearing about 45° , which leads in the channel over the flats, in depths of 4 to 6 fathoms at low water.

When the southern point of South Island bears 91° steer for it and around it at the distance of about 200 yards in order to clear two rocky patches, awash at half tide, lying about 600 to 800 yards southward of the island; when eastward of South Island steer to pass between Point Victoria and Victoria Island, all rocks being above water.

If Long and North Islands are not visible from the entrance of the channel, bring Harry Head, the northwest point of Saddle Island, to bear 91° , and the highest peak on St. Matthews Island about 302° and steer 46° , bringing Long Island just open northward of North Island as soon as these islands are seen.

Or, bring the sloping southern extreme of Boundary Island in line with a small round island eastward of it, bearing about 80° , and steer on this mark until Victoria Joint is in line with the northwestern point of Victoria Island, 66° , when steer for it, and round the northwestern point of Victoria Island at the distance of $\frac{1}{4}$ mile, the least depth being 3 fathoms.

In all the channels the flood stream sets northward and the ebb southward at the rate of 2 to 3 knots an hour.

Bell Passage.—Sailing vessels should not attempt this passage on account of the strong tidal streams, but it is used by the mail steamers.

Approach with the center of Saddle Island bearing between 108° and 63° , until about 2 miles from it, and when Tree Islet is made out steer to pass 400 to 600 yards westward of it, and in mid-channel between Spiteful Rock and Harry Head; thence pass $\frac{1}{4}$ mile northward of Stainer Rock; on this course the depths are 4 to 6 fathoms, and the banks southward of Mostyn Island are avoided.

From abreast Stainer Rock, steer toward Dyke Island, passing eastward of the rock, which is about 8 feet high and has trees on it, at the extremity of a spit extending eastward of Mostyn Island; thence pass about 400 yards eastward of Dyke Island; on this course the depth is 4 to 5 fathoms; pass about 200 yards eastward of the islands lying immediately southward of Victoria Island, where there is a depth of about 3 fathoms, and 400 yards eastward of Victoria Island, to clear the large sand bank which extends from the mainland southward of Renong River.

Caution.—As the channels are not buoyed and the chart and directions are old great caution is necessary in navigation.

Steamers passing between Saddle Island and Spiteful Rock should keep a good speed, as the tidal streams here are sometimes strong; both flood and ebb streams set toward Spiteful Rock and the sand bank southwestward of it. The tidal stream in this passage runs at rates of from 4 to 5 knots an hour at spring tides. When past Spiteful Rock there is smooth water and good shelter from the Southwest Monsoon.

Tides.—It is high water, full and change, at the anchorage off Goh Phi at 10h. 40m.; springs rise $11\frac{1}{2}$ feet and neaps $8\frac{1}{2}$ feet.

Tidal streams.—In all the channels the flood stream sets to the northward and the ebb to the southward at rates of from 2 to 3 knots an hour.

The ebb tidal stream from Pakchan River splits at the northeastern point of Victoria Island, one part setting westward and the other southward; both streams are rapid at spring tides. Tidal influence is felt in the dry season for 10 miles above Kra, at which place the spring rise is 8 feet.

Renong River, flowing into Pakchan River opposite Point Victoria, is small, narrow, and has a depth of $1\frac{1}{2}$ fathoms on its bar, the depths shoaling gradually to it from 5 fathoms westward of the buoy which marks the shoal extending from Goh Phi; nothing larger than a steam launch can cross the bar, and boats can only ascend the river for about 1 mile.

Town.—About 4 miles up Renong River is a landing place, whence a road leads to the Rajah's residence (about 1 mile from the river).

The town of Renong is steadily increasing in importance, and in its locality are large tin mines, from which a great quantity of tin is exported.

Communication.—There is fortnightly communication between Renong, Rangoon, and Penang.

Supplies.—Fresh water, firewood, and all kinds of provisions may be obtained at reasonable prices.

Settlement.—The settlement at Point Victoria, Kawsong, is the southernmost in Burma, and is a small frontier station, facing the Siamese State of Renong; it consists of about 80 bamboo huts, built under a clump of coconut palms near the point, and inhabited by Malays. On the summit of the hill at the point are the military police barracks and the houses of the assistant commissioner.

Communication.—The British India Steam Navigation Co. has a fortnightly service of steamers from Mergui, which proceed to Maliwun, and a small coasting steamer, running between Tavoy and Panang, calls about every six weeks.

River above Point Victoria.—There are apparently depths of from $4\frac{1}{2}$ to 10 fathoms in the river for about 10 miles above Point Victoria, but for this distance the banks are fronted by sand and mud flats, with channels over or between them; during the rainy season, or that of the southwest monsoon, small steam vessels reach the Siamese town of Kra, which is 40 miles from the entrance, and where the breadth of the river is about 250 feet; above this it becomes tortuous.

Kikafoi is the northernmost outpost on the river, and between it and Point Victoria the only village of importance is Maliwun, which is situated 9 miles up the river of the same name, a tributary of the Pakchan; it is a small tin-mining settlement and rubber plantation, but, the river being shallow, it is only accessible to light-draft steam vessels.

Maliwun River flows into the Pakchan River about 12 miles above the entrance of the latter, and is a broad and deep stream, available for vessels of 12 to 13 feet draft as far as the entrance to Lama River. Above that the Maliwun becomes tortuous and narrow, and can be navigated as far as the mail station by steam launches.

Directions.—From abreast Point Victoria keep in mid-channel and pass eastward of the rocks, which show above water, off Goh Korlek; then close the west bank of the river, keeping westward of all the islands up to the entrance of Maliwun River, and thence proceed in mid-channel to the anchorage below Lama River Entrance.

To proceed up Pakchan River above the Maliwun, steer between Goh Mut and Goh Khuang, where there is a depth of about $16\frac{1}{2}$ feet

at low water, then close the west bank of the river, keeping about 400 yards from it, and avoiding a rocky patch which dries about 4 feet, and lies about 300 yards off the northern entrance point of Great Kumaon River. Continue about the same distance from the west bank past the entrance of Little Kumaon River.

A rocky patch, which dries at three-quarters ebb, lies about 100 yards from the west bank, $\frac{3}{4}$ mile northward of Little Kumaon River Entrance. Vessels of light draft can proceed as far as Well Hill, about 4 miles above Little Kumaon River, keeping the west bank. Above Well Hill the river is only navigable for steamers of about 10 feet draft at high water.

Coast.—From Pakchan River entrance the coast, trending south-southwestward for about 44 miles, to the mouth of Taukopah or Kopah Inlet, is mostly low, densely wooded, and intersected by numerous rivers and creeks; not having been examined it should not be approached. A range of mountains extends along about 10 miles inland, Kau Da Chung Dung, the highest and most remarkable peak of which presents an almost perpendicular appearance. A number of islands, mostly surrounded by reefs, and connected with the mainland by sandbanks, lie off the coast.

Sugar Loaves, a group of high, bold islands, lie about 11 miles southward of Delisle Island; the group consists of Goh Jam Jai and Goh Jam Nai, two large islands, and several smaller ones. Goh Jam Jai, 700 feet in height, the largest and highest, is the western island of the group, and there is a depth of 10 fathoms 3 miles westward of it.

About 3 miles northeastward of the group is Sir Elijah Impey Island or Goh Kang Kan, high, wooded, surrounded by rocks, and having White Rock off its northern side; about 2 miles southward of the group is Metcalfe Island or Goh Lan, also high and wooded; northwestward of it is a small island and a white rock.

Hayes Island or Goh Khai Jai, about 6 miles south-southwest of Metcalfe Island and about 4 miles northward of Takua Pa, the north point of Goh Rah, is round, high, and wooded; northwestward of it is Umbrella Island, small, rocky, and with a single tree on its highest point looking somewhat like an umbrella. Both these islands are surrounded by large sand banks and rocks, and at low water the sea breaks in several places westward of them.

Pia Sima, the highest mountain in the vicinity of Kopah Inlet and about 9 miles east-northeastward of Takua Pa, culminates in three peaks, each upward of 3,500 feet high.

Goh Rah, of which Takua Pa is the northern point, is a high, thickly wooded island, with deep water along its western coast; it

lies north of Goh-Pra-Tang, and extends northward for about $4\frac{1}{2}$ miles.

Light.—It is proposed to establish a light on Takua Pa.

Shoal.—A shoal with a depth of about 3 fathoms on it lies $2\frac{1}{2}$ miles northwestward of Takua Pa.

Hayes Island and Takua Pa should not be approached within a distance of about 5 miles, except bound for Pak Kura.

Taukopah or Kopah Inlet is a large river in the province of Muang Taukopah belonging to Siam; it has three entrances, the principal one, Pak Kura, lying between Goh Rah and the mainland. For a distance of 15 miles below the town, the depth is only from 4 to 5 feet at low water springs; between this and the sea there is apparently not less than 2 fathoms.

Pak Kura—Directions.—The directions for Taukopah Inlet must be used with caution, as the survey is very old, and changes may have taken place; it is also stated that it would not be safe for a vessel of moderate size to attempt to enter it, as the soundings alter suddenly from 6 fathoms to about 2 fathoms, if any deviation is made from the channel, which is narrow and difficult to keep.

Approaching Pak Kura, steer 91° for Takua Pa, to avoid the shoal west-northwestward of it, and round the northern end of Goh Rah, at the distance of $\frac{1}{2}$ mile, where the depths are from 5 to 6 fathoms. From the northeastern point of Goh Rah steer 198° , keeping close along the island side and passing about 400 yards distant from a projecting bluff on the eastern side of Goh Rah, in order to avoid a sand pit which extends from the mainland to within 600 yards of this bluff; on this course the depths are 4 and 5 fathoms.

When past the bluff, steer 181° for about $1\frac{1}{2}$ miles, and then keep gradually round to the southeastward to the middle of the river; in this reach depths of 3 fathoms at high water have been reported. Near the end of this reach, there is a large group of fishing stakes on the mainland side and southward of two small islands, which when sighted, steer for, to clear a sandbank extending from the eastern point of Goh-Pra-Tang, and a smaller bank, with $2\frac{1}{2}$ fathoms at low water, lying 600 yards northeastward of it.

When close to the fishing stakes, steer about 226° , keeping in mid-channel, and pass eastward of a black beacon, surmounted by a cone, off Macaulay Point, marking a patch of broken ground on which, in some places, is a depth of only 9 feet at low water, spring tides; on this course the depths are 4 to 5 fathoms. In passing the beacon, the mainland side of the channel should not be approached closely, as a sand pit, which dries at low water, extends well into the channel northeastward of Feather Tree. There is

anchorage for a vessel of 12 feet draft about $\frac{1}{2}$ mile northward of Feather Tree.

Vessels of less than 12 feet draft go up the river toward Taukopah, and about $2\frac{1}{2}$ miles within the entrance anchorage may be obtained in a depth of 2 fathoms at low water, close to a small, shallow creek, at low water, passable only for small boats, through which the distance to Taukopah Town is considerably shortened.

From this upper anchorage the main river runs southeastward for about 5 miles, then south-southwestward for 4 miles, and then southward for 5 or 6 miles, and is shallow; steam cutters being only able to reach a point which is about 4 miles from the town by river and $1\frac{1}{2}$ miles by road.

Taukopah (Kopah) Town, where the rajah resides, is situated about 15 miles from the upper anchorage, on the west bank of the river, and is surrounded by tin mines and large plantations, the inhabitants being mostly Chinese. The houses are mostly of bamboo and atap, but there are some brick buildings, and a good market, where provisions and vegetables may be procured.

Besides Taukopah, which, next to Tongka, has the largest export of tin on the coast of Siam, there are several mining villages along the banks of the river, and the land about the town and to the northward is undulating and mountainous.

Communication.—There is fortnightly mail communication with Rangoon via the coast, and Penang via Tongka.

Tides.—At the anchorage 15 miles below Taukopah it is high water, full and change, at 10h. 40m.; springs rise about 10 feet, neaps 7 to 8 feet, but the tides in the river are, on account of the many outlets to the sea, very irregular.

Tidal streams.—The stream seldom runs at the rate of more than 4 knots an hour in the upper part and from 2 to 3 knots in the lower part of the river.

Along the coast from Goh Rah to the southern point of Salang Island, the flood stream sets northward, the ebb southward, at the rate of from 1 knot to 2 knots an hour, within 10 or 12 miles of the coast; farther out it is weaker and more dependent on the winds.

Pak Kruen Inlet (Bang-yee), the middle entrance to Taukopah Inlet, is about 15 miles southward of Pak Kura, and has on each side a large sandbank, partly dry at half tide, and extending from 1 mile to $1\frac{1}{2}$ miles seaward on both sides of the entrance. In the approach and distant about $3\frac{1}{2}$ miles from the entrance is a large sand flat on which is a depth of about $1\frac{1}{2}$ fathoms at low water, spring tides; this bar or flat seems to have the same depths all over and without any deeper channel across it. In the channel between the entrance points the deepest water, 5 to 7 fathoms, is along the northern bank.

Light.—On the southern shore of Pak Kruen Inlet and about 2 miles southward of Elbow Point, a fixed white light is occasionally exhibited.

Directions.—Leaving Taupoh Inlet in the northeast monsoon, this channel is safe and easy for vessels of light draft, and from between the sandbanks steer 248° to sea.

Entering this channel from seaward is more difficult, as the entrance between the sandbanks off the points can not then be seen, and it should not be attempted without local knowledge. The sandbanks here do not shift, and the passage remains the same. In the Southwest Monsoon there is generally a heavy swell on the bar, and Pak Kura is then much to be preferred.

Goh-Pra-Tang.—Northward of the entrance to Pak Kruen is Goh-Pra-Tang, a large, low, thickly-wooded island extending in a north and south direction for about 9 miles; it is separated from Goh Rah farther northward by Pak Tjik, a narrow entrance nearly choked by sandbanks and rocks, and only passable for boats. The west coast of Goh-Pra-Tang is low and sandy, with depths of from 8 to 10 fathoms about 2 miles off it.

Goh Gah, a small sandy island with a few small trees on it, situated about 1 mile from the coast about 7 miles southward of Pak Kruen, is surrounded by extensive sandbanks, which are fronted by rocks surrounded by depths of from 2 to 5 fathoms and partly visible at low water; it should not be approached nearer than 4 miles. Between the island and the mainland are sandbanks with only a few feet of water on them; 4 to 5 miles westward of the island are depths of 10 to 12 fathoms, but casts of 5 and 6 fathoms have been reported.

Pak Goh, about 4 miles south-southeastward of Goh Gah and the southern of the three entrances to Taupoh Inlet is a passage between sandbanks, said to be stationary, with depths of $2\frac{1}{2}$ to 3 fathoms at low water for about 2 miles. To enter between the sandbanks steer in with the low casuarina tree point on the southern shore bearing 113° , and inside the bar the water will deepen to 5 and 6 fathoms for a short distance, whence it becomes narrow and shallow.

The land around is low and richly wooded, but there are numerous small creeks, and at high water a large part of the country around is flooded, making it little else than a mangrove swamp. During the fine season Pak Goh may be used with advantage, but in the southwest monsoon the northern entrance is the only safe one.

Tides.—It is high water, full and change, in Pak Goh at 10h. 40m.

Tidal streams.—The flood and ebb streams are regular and run at a rate of from 2 to 3 knots an hour.

Coast.—**Lem Krang Nai** is a low point about $2\frac{1}{2}$ miles southward of Pak Goh; reefs and broken ground extend about 1 mile off it.

Lem Krang Jai, 5 miles southward of Lem Krang Nai, is a low, sandy point, covered with high trees; a rocky reef extends about 2 miles westward of it, some of the rocks of which are visible at low water. This point should not be approached nearer than 4 miles, or to a less depth than 10 fathoms; and the whole coast from Lem Krank Jai to Lem Lajan, 8 miles southward, should not be approached closely, as the ground is rocky and uneven.

The coast from Lem Krang Jai to Klong Kokak, about 4 miles southward, is low and wooded, while thence to Lem Lajan it is high, with hills close to the sea. Southward of Lem Lajan the coast is also low and wooded.

Boundary.—Lem Lajan is the western point of the boundary between the Monthons of Taukopah and Takuatung.

Klong Kokak is a river about 4 miles northward of Lem Lajan, some distance up which is the village of the same name, with important tin mines in its vicinity. Large sand banks extend off the mouth of the river. About 1 mile northward of the Kokak is a smaller river.

Lem Tham Tjob, or Cape Dolphin, the western extreme of a peninsula, is 500 feet high, bold, and steep-to, with a depth of 10 fathoms a short distance off it, and the only high point on the coast between Goh Rah, at the mouth of Taukopah Inlet, and Lem Goh Phra Chao, in Salang Island. Northward of Lem Tham Tjob the peninsula ends with a round topped hill, and rocky ground extends northward for about $\frac{1}{2}$ mile from the point, most of the rocks being visible at low water. The highland of the peninsula forms the left bank of Klong Bagatae.

Klong Bagatae or Tang Pran River is broad and 4 to 6 fathoms deep for about 3 miles within its entrance, where, abreast Klong Gatae, is a rock above water, beyond which vessels of over 8 feet draft can not ascend.

Ban Tapmo is a small village on the mouth of Klong Lam Rin, the first creek on the eastern bank, but Ban Bagatae, a large village with tin mines, is situated some miles further up this creek. Numerous creeks and small rivers fall into Klong Bagatae, and several villages are situated on its banks. Important tin mines are situated close to this river, but they are being worked under disadvantages, as, in consequence of no steamers calling here, the tin has to be carried on elephants over high hills to the Rajah's residence in Takuatung.

Anchorage.—The anchorage in the river in depths of from 3 to 5 fathoms, over muddy bottoms, is off Ban Tampo, and well sheltered from all winds.

Supplies.—Fresh provisions and water may be obtained at Ban Bagatae Village.

Directions.—Enter with Lem Lajan bearing 91° , which leads northward of the rocks extending from Lem Tham Tjob Peninsula. When the river is fairly open, steer in, keeping to the peninsula side, where the deepest water is, and inside the northern point of which there is no danger, but on the eastern side, between Lem Lajan and Ban Tapmo, is a sandbank fronted with rocks extending nearly 1 mile off shore, mostly visible at low water; anchor as directed.

Coast.—From Lem Tham Tjob the coast trends in a southerly direction for 16 miles to Bataluk, and consists of sandy beaches, with trees to the water's edge and backed by high, wooded hills; there are a few villages on this stretch of coast. Hin Lompuk, a group of rocks about 6 feet high, with depths of 5 to 7 fathoms close-to, lie about 1 mile northwestward of Bataluk, and about $\frac{1}{2}$ mile off the coast; northeastward of them are two smaller rocks close inshore.

Bataluk is an inlet fronted by shallows and banks extending off a short distance, and into which three small rivers flow—Klong Tasai from the north, Klong Kli from the east, and Klong Gva from the south; the first is the largest, and runs parallel with the coast (from which it is only separated by a sandbank) for about 4 miles, and then turns eastward; at the point where it alters its direction is Ban Tasai Village.

Supplies.—Poultry and fresh water may be procured at Ban Bang Kli, a village at the mouth of Klong Kli, and the water in Klong Tasai is fresh.

Coast.—From Bataluk the coast, which, with the exception of Hin Lompuk, appears to be clear of danger from Lem Tham Tjob, trends southward for 7 miles to Lem Pak Phra, at the entrance to Papra Strait or Pak Phra, and consists of sandy beaches with trees down to the water's edge, backed by high wooded hills.

Depths offshore.—Between Lem Tham Tjob and Lem Pak Phra the depths off the coast gradually decrease from seaward to 6 to 8 fathoms at $\frac{1}{2}$ mile offshore, but it should not be approached within a distance of 3 miles, as it has not been examined.

Lem Pak Phra, the southwestern point of the province, is noticeable by a group of high trees and a conical-shaped hill, about 200 feet high, just within it; about $2\frac{1}{2}$ miles northward of it is Koh Pilai, a small hill close to the water's edge, which is the only hill on the coast between Lem Tham Tjob and Lem Goh Phra Chao in Salang Island, but it is not easily identified.

Salang or Junkseylon Island, occupied by the Siamese of Ligor, is separated from the Malay Peninsula by Papra Strait or Pak Phra, and is about 24 miles in length, 11 miles in greatest breadth, and divided in two Rajahships of about equal size, the northern being named Salang and the southern Puket. The principal towns are

Bandon, Tongka, Kathu, and Tharua, the old capital; the population of the island, consisting of Malays, Chinese, and Siamese, being about 33,000. The north shore of Papra Strait is under the Rajah of Takuatung.

Salang Island is rich in tin mines, which appear to have been worked by Chinese miners for centuries, and in many places their primitive method is adopted, with the result that during the dry season operations are stopped for want of water.

West coast.—The west coast of Salang Island trends in a southerly direction, with some projections for nearly the whole length of the island, and has several large bays with deep water, but none affording any protection during the southwest monsoon; except for a small portion about 8 miles from the north point, the northern part of this coast is low and wooded, with hills of moderate height immediately within it.

The southern part is a range of mountains from 1,000 to 1,750 feet high, thickly wooded, and sloping gradually northward and southward, and the whole of this side of the island is steep-to, with 10 or 12 fathoms close to the shore. Goh Gavai, two small islands, one of which is 50 feet high, the other lower, lie close together 1 mile southwestward of Lem Son, 8 miles southward of the northwestern point of the island, and have deep water around them.

Bandon River enters the sea just south of Lem Son; on it is the town of Bandon, which contains about 100 houses; population estimated at 9,000.

Pak Phra or Papra Strait, about $\frac{1}{2}$ mile in width and separating Salang Island from the Malay Peninsula, is about 14 miles long, the land on both sides being mostly low and wooded, but the capes or lems are high, with hills of moderate height on the northern side. The natives are very superstitious about this strait (its name signifying Lord's mouth), which is much used by junks. Along both shores of the strait are several villages where provisions and water may be obtained.

The narrowest part of Papra Strait is between Lem Hin on the mainland and Lem Khun on Salang Island, eastward of which there is a sand bank, dry at low water; southward of this bank the depth is 9 feet at low water, while there are 4 and 5 fathoms on the northern, western, and eastern sides of it. Another large sand bank extends from the western side of Lem Asam, the channel lying between it and the bank just described.

Goh Galah, a small white, rocky island, is situated $1\frac{1}{2}$ miles south-eastward of Lem Khun, and Goh Janak is a small island lying $\frac{1}{4}$ mile southwestward of Goh Galah. Southwestward of Goh Janak there are extensive sand banks, dry at low water, and southward is Tamaprau River, with the town of the same name on its banks 2

miles from the mouth; Muang Mai, a larger town, is situated $1\frac{1}{2}$ miles farther southward, but boats can not go beyond Tamaprau.

Bar—Depths.—The depth on the bar at the western entrance, which is subject to great change, varies from 1 to 3 fathoms at low water, and the channel is tortuous and difficult even for boats, so that the passage of the strait should not be attempted without the assistance of a pilot. Off the northern entrance point a reef of rocks, only visible at low water, extends a short distance; shallow and shifting sand banks front both points.

In the southwest monsoon the sea breaks entirely across the western entrance, but in the northeast monsoon the bar is generally smooth.

Anchorage.—Inside the bar there is good anchorage in depths of from 5 or 6 fathoms; and thence to Lem Khun, $4\frac{1}{2}$ miles within the bar, there is a good channel with from 4 to 6 fathoms at low water.

There is also good anchorage, in 4 or 5 fathoms water, eastward of Goh Janak and Goh Galah.

Directions.—Proceeding eastward, pass 400 yards northeastward of Goh Galah, and then steer to pass 300 yards off Lem Sai; in this part there are depths of 4 and 5 fathoms. Then steer to pass about 400 yards northward of Goh Rangam Jai, a round island, like all the rest in this locality, covered with trees; between these two places the channel, which is formed between the fringing sand banks, is little more than 200 yards wide, and has 12 feet at low water, spring tides, with soft mud bottom.

From Goh Rangam Jai steer to pass about 600 or 800 yards southward of Goh Rangam Noi, the water gradually deepening as the latter is approached; pass Sam Lem or Cape Three Points, the northeastern point of Salang Island, from 600 to 800 yards distant, in a depth of 7 fathoms, 1,000 yards southward of Goh Leng and 600 yards northward of Goh Thanan or Pulo Chupo, a small round island 1 mile eastward of Sam Lem. Leave Goh Thanan about 1 mile to the westward, and then, if bound to Tharua Harbor, steer between Goh Ret and Goh Naka Joi, in about 6 fathoms water.

Tides.—The tides in Papra Strait are very irregular. At the bar the times of high and low water seem to correspond nearly with those at Puket, where it is high water, full and change, at 10h. 10m.; the tides rise from 6 to 8 feet in the middle of the strait.

Tidal streams.—In the strait the stream of the flood sets in from both sides and meets at the sand bank of Lem Khun, and the ebb stream runs out of both entrances to the strait. In the middle of the strait there is hardly any tidal stream, but at the western entrance the tidal stream sometimes attains a rate of 6 knots, with only half that velocity at the eastern entrance.

For the description of the remaining portion of Salang Island and the adjacent coast, see Asiatic Pilot, Volume VI.

Pulo Raja, situated 10 miles southward of Salang Island, rises to a height of 1,064 feet in its southwestern part, while its northeastern part is low.

Gulnare Cove, at the northwestern point of Pulo Raja, is about $\frac{1}{2}$ mile long by $\frac{1}{4}$ mile wide, having a depth of 9 fathoms, over sand, in the center. There is a small inlet on the northern side of Pulo Raja, into which a stream flows.

Overfalls.—There are heavy overfalls between Pulo Raja and Brothers Islands.

Brothers Islands, situated about 15 miles southward of Salang Island, are densely wooded, steep-to, and nearly connected by a reef. The northern island, 517 feet high, has a detached rock lying 700 yards off its northern end. The southern island, 239 feet high, is of nearly uniform height; a reef extends about 1 mile from its southern point.

Currents.—Southward of Salang Island during the northeast monsoon the current sets northwestward; during the southwest monsoon it sets southeastward, but after strong westerly or west-north-westerly winds the current southward of Brothers Islands sets eastward.

APPENDIX I.

Particulars of dry docks, patent slips, etc.

Port.	Name of dock.	Length.		Breadth of entrance.		Depth at M.H.W.S.		Lifting power.	Remarks.
		On blocks.	Over all.	Ft. In.	Ft. In.	On sill.	On blocks.		
Calcutta.	Caledonia Dock.....	Ft. In. 342 0	Ft. In. 367 0	Ft. In. 44 6	Ft. In. 115 9				Can be lengthened 150 feet. When two depths are given the greater is the average between June and October, and the lesser the same from November to May. The Commercial Dock can be lengthened 40 feet. The Hugh Dock has a well for unshipping rudders. Not used for docking.
	Hugh.....	305 0	310 0	44 0	{ 22 0 17 6	{ 13 4 8 10	{ 21 0 16 6		
	Commercial.....	230 0	234 0	41 0					
	British India Steam Navigation Co.: Howrah—Upper.....	308 0	334 0	50 6	20 6		18 0		
	Lower.....	190 0	209 0	40 6	19 2				
	Union: Upper.....	342 6	350 0		17 3				
	Lower.....	362 6	368 0	56 6	19 3		18 6		
	Kidderpore, Government New Dock.....	347 6			23 6		22 0		
	Port commissioners: No. 1.....	538 9	549 0	69 6	25 0		24 0		
	No. 2.....	488 6	496 6	66 6	27 0		24 0		
	I. G. S. N. Co.: East Dry Dock.....	614 0			7 6				
	West Dry Dock.....	634 0		66 0	4 6				
	Rivers S. N. Co.: No. 1.....	508 0	510 0	59 6	15 0		12 6		
	No. 2.....	392 0	385 0	59 6	14 6		12 6		
	Kidderpore Steam Dock.....	179 0	190 0	46 3					
	New Dry Dock.....	217 6	221 9	45 6	17 0		17 3		
	Patent slips: I. G. S. N. Co.— No. 1.....	\$ 250 0					{ 7 0 11 6	700	
	No. 2.....	\$ 212 0					{ 10 6 13 6	400	
	No. 3.....								
	Rivers S. N. Co.— No. 1.....	\$ 55 0					{ 10 6 12 0	60	
	No. 2.....	\$ 230 0					{ 12 0 15 6	600	
	No. 3.....	\$ 246 0					{ 12 0 20 0	900	

	1 Approximate.	2 Cradle.	3 Forward.	4 Aft.
Akyab.....	Patent Slip.....	287 0	{ 3 0 } 80	.....
Moulmein.....	do.....	2110 0	{ 4 4 6 } 90	.....
Rangoon.....	do.....	2180 0	{ 12 17 0 } 1860	.....
Gridiron.....	.....	245 0	{ 3 7 0 } 1860	.....
		230 0	{ 4 10 0 } 1860	.....
			13 0	.....

APPENDIX II.

Particulars of wet docks, basins, locks, etc.

Port.	Name of dock, basin, etc.	Area.	Length.	Breadth.	Depth.	Entrance.		Lock.			Quay-age.	Date built.
						Depth at M.H.W.S.	Width.	Length.	Breadth.	Depth at M.L.W.S.		
Calcutta.	Basin.	Acres. 9½	Fed. 600	Fed. 680	Fed. 34	Fed. 134	Fed. 80	Fed. 1400	Fed. 60	Fed. 134	Fed. 600	Year. 1892
	Wet dock.											
	No. 1.		2,700	600	30		60				5,400	1892
	No. 2.		4,500	400	30		80				6,816	

1 38 feet during freshets.

1 520 feet with caissons in outer stops.

APPENDIX III.

List of principal ports, giving particulars of depths, etc.

Port.	Depth at L. W. O. S. in channel of approach.	Depth at L. W. S. T. at anchorage.	Rise of tide.	Remarks.
Madras.....	6 fathoms.....		(Spring, 3½ feet..... Neap, 2½ feet.....	Anchorage at Chand- ball. { At high water, springs, vessels of 28 feet, and at high water, neaps those of 24 feet can reach Calcutta.
Devi River.....	8 feet.....	3 fathoms.....	(Spring, 9 feet..... Neap, 6½ feet.....	
Dhamra River.....	9 feet.....	22 to 30 feet.....	(Spring, 6½ feet..... Neap, 6 feet.....	
Calcutta.....	13 feet.....	22 to 30 feet.....	(Spring, 15½ feet..... Neap, 12½ feet.....	
Sagar roads.....	14 feet.....	5 to 8 fathoms.....	(Spring, 17 feet..... Neap, 12 feet.....	Steamers drawing 10 feet reach Narayan- ganj at high water. Vessels of from 25 to 28 feet enter at high water.
Matia River:	.....	.....	.....	
West Channel..	4 fathoms.....	4 to 8 fathoms at Canning Town.	Spring, 10 feet.....	
East Channel..	5 fathoms.....	.....	.....	
Meghna River.....				
Chittagong.....	9 feet.....	18 to 42 feet.....	Spring, 14 to 16 feet.....	
Naaf River.....	13 feet.....	About 4½ fathoms off Maungdaw.	(Spring, 8 to 10 feet..... Neap, 6 to 8 feet.....	
Mayu River.....	19 feet.....	6 to 9 fathoms.....	(Spring, 8 to 9 feet..... Neap, 6 feet.....	
Arakan River.....	21 feet.....	6½ fathoms at Out- er and 4 fathoms at Inner anchor- age.		
Ramree Harbor.....	.....	3½ to 4 fathoms.....	(Spring, 11 feet..... Neap, 8 feet.....	
Nicobar Islands:	.....	.....	.....	
Nankowry Har- bor—	.....	.....	.....	
East Entrance.	19 to 22 fathoms.....	11 to 21 fathoms.....	Spring, 8 to 8½ feet.....	There is a depth of about 3 fathoms in the strait.
West Entrance.	27 to 30 fathoms.....	.....	.....	
Expedition Harbor	9 to 13 fathoms.....	12 fathoms.....	Spring, 8 feet.....	
Andaman Islands:	.....	.....	.....	
Port Blair—				There is a depth of about 2½ fathoms in the strait.
South Channel.	31 feet.....	7 to 8 fathoms.....	Spring, 6 feet..... Neap, 5 feet.....	
North Channel.	21 fathoms.....	.....	.....	
Andaman Strait,	1½ fathoms.....	.....	(Spring, 7 to 8 feet..... Neap, 4 to 6 feet.....	
East Entrance.				A vessel of 26 feet draft has reached Bassein Town.
Port Anson.....	11 fathoms.....	9 to 11 fathoms.....	(Spring, 7 feet..... Neap, 5 feet.....	
Homfray Strait....	1½ fathoms.....	.....	.....	
Port Mout.....	7 to 10 fathoms.....	4½ to 5 fathoms in Inner Harbor.	Spring, 5 feet.....	
Bassein River.....	3½ fathoms (less re- ported).	7 fathoms.....	(Spring, 7½ feet..... Neap, 5½ feet.....	H. M. S. Terrible, drawing 30 feet 1 inch, entered the port of Rangoon in 1906.
Rangoon River:	.....	.....	.....	
West Entrance.	19 feet (shoaling reported).	.....	(Spring, 19 feet..... Neap, 13 feet.....	
Monkey Point Channel.	14 feet.....	26 to 30 feet.....	.....	

List of principal ports, giving particulars of depths, etc.—Continued.

Port.	Depth at L. W. O. S. in channel of approach.	Depth at L. W. S. T. at anchorage.	Rise of tide.	Remarks.
Irrawaddy River...				Navigable to Bhamo 800 miles from sea, by steamers of 4 feet draft during the whole season, and to Thayetmyo, 364 miles from sea, by those of 6 feet draft, during the dry season.
Bassein Creek.....				Vessels drawing 8 feet water can pass through.
China Bakir River.....				Vessels of 15 feet draft can enter.
Moulmein River... 8 feet.....		30 to 40 feet.....	{Spring, 14 feet..... {Neap, 7 feet.....	Navigable to Moulmein for drafts of 25 and 18 feet, at springs and neaps, respectively. Vessels of 13 feet draft can reach Ye Town at springs. Vessels of 25 feet draft can enter at springs, and of 19 feet at neaps.
Ye River..... Bar dries.....			{Spring 15 feet..... {Neap, 9 feet.....	
Heanzay Basin..... 14 feet.....		7 fathoms.....	{Spring, 15 to 16 feet {Neap, 8 to 11 feet..	
Tavoy River, Grindstone Island.	28 feet.....	30 feet.....		
Tainbyubin and Tavoy.	12 feet.....	13 feet.....		
Mergui.....	1½ fathoms.....	3½ to 5½ fathoms.....	{Spring, 18 feet..... {Neap, 11 feet.....	
Pakchan River:				
North Channel.	2½ to 3 fathoms.....	3½ fathoms at Victoria Point.	{Spring, 11½ feet.... {Neap, 8½ feet.....	
South Channel.	3 fathoms.....			

INDEX.

A.		Page.		Page.
Active Split.....	224	Andaman Islands.....	83, 285	
Adams Point.....	250	—— caution.....	84	
Agandu Range.....	239	—— climate.....	84	
Agga lod baraij.....	306	—— earthquakes.....	84	
Agra Rock.....	165	—— monsoons.....	84	
Akyab District.....	64, 237	—— physical features.....	83	
—— climate.....	65	—— ports.....	84	
—— communication.....	65	—— products.....	84	
—— products.....	65	—— trade.....	84	
—— rivers.....	64	—— winds and weather.....	84	
—— port.....	242	—— port.....	323	
—— coal and supplies.....	244	—— Strait.....	300, 323	
—— directions.....	243	—— depths.....	301	
—— town.....	244	Anderson Rock.....	310	
Aladdin Islands.....	440	Andrew Bay.....	265	
Alexandra Channel.....	330	—— Point.....	442	
Alfred Point.....	279	Andromeda Point.....	328	
Alguada Reefs.....	334	Angrei Kyong.....	246	
Alice Island.....	434	Anson, port.....	324	
Allamparwa River.....	128	Ant Islet.....	409	
Allen Patches.....	327	Apan-ye Islet.....	265	
—— Peak.....	396	Arabann Island.....	416	
Alligator's Head.....	270	Arakan River.....	241	
Alun Sand.....	354	—— Yoma.....	64, 272	
Amarafura, city.....	368	Arasalar River.....	121	
Amelia Crossing.....	380	Archipelago, the.....	301	
Amherst.....	378	Areka, Rivulet.....	285	
Amherst District.....	75, 384	Argo Flat.....	216	
—— climate.....	77	Ariel Ledge.....	287	
—— communication.....	77	Armagon Light.....	141	
—— ports.....	77	—— Shoal.....	141	
—— products.....	76	Arong, village.....	285	
—— rivers.....	76	Asirgarh Shoal.....	238	
—— trade.....	77	Atalanta Bay.....	314	
—— Point.....	375	—— Point.....	294	
Amnam Hill.....	164	Atharabanka River.....	211	
Amylnpoma Islands.....	411	Auckland Bay.....	422	
An River.....	247	Auriol Island.....	441	
		Austen Islet.....	323.	

	Page.		Page.
Austin Strait.....	323	Bansgarh River.....	183
Ava, city.....	367	Bara Panga River.....	215
Aves Island.....	311	Barata Bay.....	293
— Point.....	311	Baratang Island.....	307
Awl Island.....	435	Baratola River.....	212
Aye Island.....	388	Bare Hill.....	258
B.		Bargua Flats.....	341
Babeswal Temple.....	173	Barisal River.....	217
Back Bay.....	315	— Town.....	217
Bacon Bay.....	310, 312	Barkal Rapids.....	223
Baghkali Creek.....	231	Barker Point.....	249
Bahiraswami Temple.....	153	Barn Island.....	248, 434
Bailey Island.....	427	— Islet.....	412
Baitarani River.....	187	Baronga Island.....	245
Bakud Creek.....	180	— Point.....	246
Balasore District.....	56, 189	Baroni Rock.....	337
— climate.....	58	Barren Island.....	292
— communication.....	57	Baruva.....	168
— ports.....	57	— anchorage.....	168
— products.....	57	— beacons.....	168
— railways.....	58	— communication.....	168
— rivers.....	57	— landing.....	168
— trade.....	57	— lights.....	168
— port.....	192	— supplies.....	168
— communication.....	192	— tides.....	168
— cyclonic storms.....	193	Bassein.....	340
— storm signals.....	192	— Creek.....	350
— supplies.....	192	— District.....	68, 268
— trade.....	192	— climate.....	69
— Road.....	189	— communication.....	69
— town.....	192	— products.....	69
Balchari Sand.....	212	— railways.....	69
Baleswur Temple.....	176	— rivers.....	68
Balfour Reef.....	308	— trade.....	69
Balijori Obelisk.....	177	— radio station.....	340
Balisal Point.....	189	— River.....	336
Balu Islet.....	417	Bataluk Inlet.....	454
Balugyun Crossing.....	380	Bath Bun Island.....	389
— Island.....	373	Batten Beacon.....	224
— Sands.....	376	Batti Malv Island.....	284
Bamboo Flat Bay.....	296	Bavanapadu Beacon.....	167
Ban Bagatae.....	453	— village.....	167
— Tapmo, village.....	453	Bazangu Island.....	428
Bandon River.....	455	Beacon Hill.....	241
Bangaduni River.....	215	— Islet.....	255
— Sand.....	215	— Light.....	255
Bangara River.....	216	Beauchamp Patch.....	290
Bang-ye Inlet.....	451	— Reef.....	317
Banlin River.....	445	Bedford Islets.....	434
Banrim River.....	445	Bell Passage.....	447
		Bendi Hills.....	167

	Page.		Page.
Bengal, Bay of	31	Bimlipatam, storm signals	163
— barometer	90	— supplies	163
— bores	101	— tides	163
— coaling station	105	— trade	164
— currents	98	Bingham Rock	246
— cyclones	88	Binnacle Rock	330
— fishing vessels	103	Bird Rocks	431
— general remarks	93	Birkul bungalows	193
— magnetic variation	107	Black Hill	253
— mud volcanoes	101	— Hummock	237
— passages	107	— Pagoda	176
— pilot vessels	103	— Point Beacon	181
— radio information	98	— Rock	272, 428
— radio stations	105	Blackwood Harbor	142
— searchlights	104	Blair Point	296
— soundings	102	— Port	293
— storm signals	94	— coal	298
— surface tempera- ture	102	— communication	297
— tides	100	— repairs	298
— time signals	105	— Reef	295
— weather signals	97	Bluff Cape	267, 326
— winds	85	— Island	326
— Province	52	— Point	321, 384
— districts	53	Blundell Island	424
— products	53	Blunt Island	438
— weights and measures	113	Boa-pong	321
Bengala	283	Boat Island	290
Bengara Peak	239	— Rock	274, 433
Bentinck Island	428	Bokpyin Creek	433
— Point	385	Bold Promontory	436
— route	420	Bolton Shoal	322
— Sound	386	Bombay Shoal	250
Beresford Channel	282	Bomle Bay	269
Berhampore	171	Bompoka Island	283
Berkeley Group	311	Bond Harbor	317
Bertie Island	416	Bopung Island	314
Best Clump	236	Borarrria Point	187
Bhadra Reef	432	Boroln-Erema	303
— Rock	433	Bound Island	421
Bhainrab River	211	Bowendoung Peak	267
Bhamo, city	370	Bowers Island	425
Bhargavi River	173	— Reef	412
Bidiapur, town	189	Bowman Passage	249
Bihar and Orissa Province	52	Boyce Headland	437
Bimlipatam	163	— Hill	437
— anchorage	163	Boyut Island	436
— communication	163	Braganza Ledge	324
— landing	164	Brahmani River	184
— light	163	Brahmaputra River	218
— repairs	164	Breaker Point	324
		Brigade Creek	296

	Page.		Page.
Chandpur	220	Chittagong District, communica-	
Channel Clump	259	tion	62
— Creek	212	— ports	62
— Rocks	442	— products	62
Chanuya, village	193	— railways	63
Chara Juru	309	— rivers	61
Chargutia Point	191	— trade	62
Charka-erema	304	Chogada Island	288
Charka Juru	305	Choki Lump Shoal	350
Charles Ross Hill	429	— Point Range Lights	351
Charts	11	Chofta-luk	321
— use of	13	Chota Ghira Point	191
Chatham Island	296, 314	Chowra Island	283
Chauga len jing	306	Christie Island	441
Chaukdaw Rock	401	Christmas Island	422
Chaung-gyi Island	270	Christobel Island	426
Chauntanaung village	435	Church Rocks	268
Cheding Flats	434	Cinque Islands	288
— town	433	— Rocks	324
Cheduba Creek	256	Clara Island	435
— Island	254	Clough Passage	318
— Strait	253	— Rocks	318
— Town	256	Cocanada	155
Chengalpat District	39, 129	— anchorage	156
— climate	41	— Bay	155
— communications	40	— coal and supplies	158
— products	40	— communication	158
— railways	40	— current	158
— rivers	39	— directions	156
— trade	40	— harbor lights	156
Chevallier Islet	424	— repairs	158
— Rock	424	— tides	157
Chicacole, town	165	— trade	158
Childers Channel	262	— tugs	156
Chilka Lake	172	Cockburn Islets	440
— Mouth	173	Coco Channel	329
Chillumbrum Pagodas	123	— Group	329
Chimakurti, Mount	145	Colebrooke Island	308
China Bakir Flats	345	Coleroon Point	123
— Light	342	— River	123
— River	361	Combermere Bay	247
— directions	362	Combs Pillar	224
Chindwin River	366	Command Bay	296
Chingleput District	39	— Point	296
Chingri River	223	Compass, the	21
Chiriyatapu Point	291	Cone Islet	412
Chirume Island	316	Conical Mountain	272
Chittagong	226	Connaught, Cape	278
— approach	221	Conspicuous Rock	246
— winds	228	Constance Bay	327
— District	61, 221	Convlet Patch	311
— canals	63	Coral Bank	440
— climate	63	Corbin Island	425

	Page.		Page.
Coringu	156	Dalrymple, Cape	308
— Bay	155	Danai Peak	172
— River	156	Dandrasl Hill	169
Cornwall Point	409	Danger angle	22
Cornwallis, Port	313	Danson Bay	269
Coromandel Coast	118	Daphne Rock	330, 428
Courts Island	428	D'Apres Shoal	218
Covelong	130	Dark Hill	254
— Point	130	Daughlish Island	421
Cow and Calf Islets	333	Davis Island	440
Cowcolli Light	194	Daya River	173
Coxs Bazar	232	Delisle Island	444
— Beacon	231	Deoban, Mount	276
Crab Island	402	Deserters Creek	346
Craggy Island	313	Devi Point	176
Crawford Shoal	271	— River	176
Crichton Island	436	— anchorage	177
Crooked Island	248	— entrance	177
Cuddalore	125	— landing	177
— anchorage	125	— tides	177
— climate	126	Devils Hole Range Lights	350
— coal and supplies	125	— Point	281
— communications	125	Dhamra River	184
— light	125	— buoys	186
— storm and weather signals	125	— directions	186
— town	125	— pilots	186
— trade	126	— south channel	186
Current arrows	19	— village	186
Cuthbert Bay	310	Diamond Harbor	207
Cuttack, city	178	— Island	336
— District	55, 176	— Light	337
— canals	55	— radio station	337
— climate	56	Dicey Shoal	249
— communication	56	Dickenson Channel	252
— population	56	Digwah Mohan	193
— products	56	Diligent Strait	307
— railways	56	Dindi House	147
— rivers	55	Dinga Bar	191
— trade	56	— Flat	191
Cutters Patch	262	Divi Point	148
— Rock	259	— landmark	148
Cypress Point	236	Dolphin, Cape	453
— Sands	236	— Islands	436
		— Shoal	229
D.		Dolphins Nose	160, 394
Da Silva North Point	350	Domal Island	429
— Shoal	350	Dombak Point	233
Daisy Rocks	412	Dongalkonda Beacon	159
Dalhousie Fort Point	250	Donnelly Island	431
— Point	213, 339	— Reef	431
— Sand	213	Double Island	385
Dalrymple Bank	286	Douglas Point	187

	Page.
Dowdeswell Island.....	179
D'Oyley Peak.....	320
Dragon Shoal.....	259
Dring Harbor.....	281
Druid Rocks.....	433
Drunken Sailor Rock.....	263
Dugarazupatnam.....	142
Duncan Island.....	299
— Passage.....	287
Dundas Point.....	296, 313
Dunkin Island.....	441
Dyke Islands.....	444

E.

E Island.....	440
East Bay.....	277
— Island.....	304, 317
— Islet.....	409
— Reef.....	262
— Spur.....	427
Easter Point.....	279
Eastern Baronga.....	246
— Bay.....	426
— Bengal.....	61
Eastern Channel (Hugli River).....	203
— Lightvessel.....	195
— (Matla River).....	213
— Grove Flats.....	345
— Sands.....	346
— Sea Reef.....	203
— Shoal.....	278
Edcumbe Point.....	281
Edinburgh, cape.....	276
Edmond Island.....	429
Egu Belong Island.....	286
Elbow Point.....	402, 452
Elephant Island.....	429
— Point.....	233, 345
— Rock.....	433
Elfin Patch.....	313
Elizabeth Island.....	247
Elphinstone Harbor.....	309
— Island.....	424
— Mount.....	424
Empress Peak.....	276
Ennore Beacon.....	139
— Shoal.....	139
— village.....	133
Entrance Hill.....	301
— Island.....	425
Entry Island.....	299

	Page.
Evans Island.....	421
— Ridge.....	385
Excelsior Island.....	316
Expedition Harbor.....	281
Eyles Island.....	436

F.

Fakir Hill.....	221
— Point.....	241
— Reef.....	242
Fakirmura Hill.....	239
Falle Islet.....	417
False Bay.....	183
— Kettlebottom Hill.....	140
— Point anchorage.....	179
— directions.....	181
— Divi.....	147
— Light.....	179
— Rock.....	262
Farasdanga.....	192
Fat Hill.....	272
Father Islet.....	435
Fathom curves.....	14
Fell Island.....	420
— Passage.....	418
Fenton Point.....	396
Festing Island.....	444
Finger Peak.....	129
Fink Island.....	431
Fish Harbor.....	440
— Trap Point.....	395
Five Fathom Patch.....	311
— Sisters.....	432
Fixing position.....	19
Flat Island.....	242, 323
— Spit.....	242
— Reef.....	259
— Rock.....	292
Flatt Island.....	257
Fletcher Hayes Straits.....	248
— Island.....	427
Fly Islet.....	431
— Rock.....	432
Fog signals.....	16
Ford Bay.....	330
Fords Peak.....	289
Foreland, the.....	436
Forfar Rock.....	430
Forrest Passage.....	435
— Strait.....	435
— directions.....	437

	Page.
Guire Point	188
Guitar Island	308
Gulnare Cove	457
Gundlakamma River	146
Gungasager Rocks	260
Guntur District	43, 145
—— ports	43
Gwa Bay	267
—— Island	268
—— town	268
Gwataung, hill	264
Gyun Gyi	389

H.

H. Prinsep Island	427
Haing-gyi Island	338
Half Moon Reef	436
—— Tide Rock	324
Hand Peak	315
Hanthawaddy District	72, 344
—— canals	74
—— climate	74
—— communication	73
—— ports	73
—— products	73
—— railways	74
—— rivers	73
—— trade	73
Haoin	283
Harchandi Temple	173
Hariabhanga River	215
Harriet, Mount	296
Harris Island	410
Harry Head	444
Hastings Harbor	439
—— Sand	352
—— Shoal	352
Hatia Bar	219
Hattrass Passage	427
Havelock Island	302
Haycock Island	426
—— Rock	441
Hayes Island	425, 449
Hayward Island	438
—— Point	273
Headlam Patch	310, 390
Heanzay Basin	394
Heath Rock	430
Heckford Bank	440
—— Patch	241
Helby Hummock	254
Henry Lawrence Island	304
—— Rocks	255

Herbert Island	408
Hext Rock	422
Heywood Channel	261
Hgnettaung Islets	270
Hickman Shoal	319
High Island	269, 435
—— Peak	267
—— Peaked Island	431
—— Rock	412
Hill Island	257
Hinam, village	283
Hinze Basin	394
Hmau-gon Pagoda	266
Hmawwun Lumps	350
Hnet thalk taung	400
Ho Ho Bay	281
Hoare Island	389
Hobday Island	290
Hodge Point	241
Hoinipoh Bay	277
Homfray Strait	309, 326
Hope Island	153
—— Point	388
—— Town	296
Hood Point	314
Hooper Patch	328
Horace Point	281
Horsburgh Island	440
Howard Islands	408
Howrah Docks	208
Hsengma Island	270
Hswathwa River	267
Htein Chaung	410
Hudson Bay	322
Hugh Rose Rock	334
Hugli River	200
—— approach	194
—— directions	196
—— bore	202
—— buoys	200
—— caution	197
—— depths	200
—— directions	198
—— lightvessels	194
—— Lloyd's signal stations	199
—— pilot vessel	196
—— pilotage	196
—— radio station	196
—— special quarantine regu- lations	198
—— storm signals	205
—— tides	201
—— winds and weather	199

	Page.		Page.
Huki-tala	179	Jimkhana	192
Hump Island	323	— Bar	192
Hunter Bay	246	John Lawrence Island	304
Hurrichpur River	177	Johnny Island	421
Hurripur Reach	187	Jolly Boys Island	290
Hydrographic Bulletins	13	Jones Point	311
I.		Jotdar River	178
Ichapur Hill	169	Juanita Shoal	272
India	31	Juldia Hill	222
— districts	33	Julia Island	421
— uniform system of buoyage	105	Julian Island	431
Indian Point	279	Jungle Point	191
Inglis Island	304	K.	
— Patches	305	Kabra Island	274
Inner Split	231	Kaduveiyaru River	119
Intermediate Lightvessel	203	Kaga River	216
Interview Island	323	Kaicha-wa	306
Investigator Channel	440	Kaichawa erema	303
— Ledge	267	Kakana	284
— Patch	330	Kala Island	412
— Rock	169, 289	Kaladan River	241
Invisible Bank	292	Kalibhanj Island	185
Iron Island	409	Kalikoti, town	189
— Passage	409	Kalingapatam	166
Irrawaddy River	335	— anchorage	166
— banks	371	— Light	166
— inner navigation	359	— storm signals	166
— routes	360	— supplies	166
— upriver pilots	360	— tides	166
— Rock	251	— trade	167
Iskapalli, village	144	Kalpi Anchorage	207
Isle of Man	282	Kalwin Point	405, 413
J.		Kambakam Durgam	140
Jack Island	430	Kamyit River	266
Jackson Creek	286	Kanarak Pagoda	176
— Ledge	318	Kandalur Hill	145
Jagannath	174	Kandivalasa Peak	164
— Pagodas	174	Kandleru River	143
Jail-erema	304	Kandukur, Town	145
Jajpur, town	184	Kanika Sand	185
Jalattaung Island Light	264	Kantaung Promontory	395
Jaleswar, village	193	Kantu Rocks	406
Jambu location	183	Kaptai River	223
— River	180	Karathuri, village	435
Jamira River	213	Karikal	121
Jamuna River	215	— bar signal	121
Jellasore, village	193	— coal and supplies	122
Jerry Islet	330	— communication	122
Jessop Hill	320	— current	122
Jhuta Bar	187	— landing	122
		— landmarks	121

	Page.		Page.
Karikal, signal station.....	121	Kistna District, communications..	45
— tides.....	121	— — geology.....	44
— trade.....	122	— — minerals.....	45
— winds.....	122	— — ports.....	45
— Territory.....	35	— — products.....	45
— — communication.....	36	— — railways.....	45
— — products.....	35	— — rivers.....	44
— — railway.....	36	— — trade.....	45
Karnaphuli River.....	223	— Light.....	148
— — bars.....	224	— River.....	148
— — beacons.....	224	Kistnapatam, town.....	143
— — buoys.....	225	Kitthareng Island.....	432
— — directions.....	222, 225	Klong Bagatae River.....	453
— — eastern bank.....	223	— Kokak River.....	453
— — light.....	222	Knot Islet.....	249
— — tide gauge.....	224	Kodigeri Bungalows.....	117
— — tides.....	226	Kohinur Shoal.....	233
— — western bank.....	223	Koi-hou, village.....	282
Kasalang River.....	223	Konada, town.....	164
Katchall Island.....	277	Kondul Harbor.....	275
Katha, city.....	370	— Island.....	274
Kathemawgyum.....	401	Konijedu Hill.....	145
Katjuri River.....	178	Kopah Inlet.....	450
Kattivakkam, village.....	138	— Town.....	451
Kau Da Chung Dung Peak.....	449	Kora thalpit.....	322
Kaulvada Hill.....	164	Koronge Island.....	271
Kawdwe Island.....	412	Kotapalem Beacon.....	152
— Rock.....	412	Kotara Anchorage.....	298
Kawmwe Islet.....	413	Kottapatam.....	145
Kayaing Creek.....	261	— communication.....	146
Keating Point.....	284	— Obelisk.....	145
Kemios Bay.....	284	— port.....	145
Kennedy Island.....	431	— shoal.....	146
Keokpadang Pagoda.....	386	— town.....	145
Kerawa.....	283	— trade.....	146
Kettlebottom, False.....	140	— village.....	142
— Hill.....	140	Kowita Beacon.....	169
Keuain Kaun Taung.....	247	— Tableland.....	169
Kharsua River.....	184	Koyob, Mount.....	298
Khirsinga Hill.....	167	Krapo Island.....	384
Khulna.....	211	Krishna Shoal.....	342
Klantaung, mount.....	400	Kropik Island.....	386
Kikafol.....	448	Krunangi Peak.....	394
King Point.....	409	Kubwet.....	369
Kings Bank Channel.....	352	Kudur, village.....	142
— Island.....	410	Kujidaba Peak.....	172
— Sound.....	410	Kulagaik Island.....	386
Kinserley Point.....	310	Kumla Island.....	411
Kisseraing Island.....	432	— Patch.....	411
Kistna District.....	43, 148	Kuniwa, village.....	366
— — canals.....	44	Kurrachee Rock.....	437
— — climate.....	45	Kushhadra River.....	176

	Page.		Page.
Kutkonda Beacon.....	160	Lem Asam.....	455
— Promontory.....	160	— Hin.....	455
Kutubdia Island.....	229	— Khun.....	455
— — Light.....	222, 229	— Krang Jai.....	453
Kwang la Pagoda.....	374	— — Nai.....	452
Kwangtung Point.....	273, 311	— Lajan.....	453
— Strait.....	304	— Pak Phra.....	454
Kwethongyima Promontory.....	395	— Tham Tjob.....	453
Kyang-yaung Point.....	259	Lenga River.....	433
Kyaukpyu District.....	65, 246	Letsari Islets.....	417
— — climate.....	66	Lichune Island.....	271
— — communication.....	66	Lifey Island.....	351
— — ports.....	66	Light Lists.....	12
— — products.....	66	Lighthouse Sand.....	212
— — rivers.....	66	Lights.....	15
— — telegraph.....	66	Limlor Island.....	416
— — trade.....	66	Lion Rock.....	424
— Harbor.....	248	Little Andaman Island.....	286
— — directions.....	251	— Canster Island.....	408
— town.....	252	— Coco Island.....	329
Kyaung-Tha River.....	269	— Kumaon River.....	449
Kyd Island.....	298	— Nicobar Island.....	276
Kyeintali River.....	266	— Quoin Island.....	270
Kyetiki Gyun.....	389	— Torres Islands.....	427
Kyong Siya.....	247	Livermore Shoal.....	389
Kywide River.....	239	Londabans Hill.....	171
L.		Long Island (Homfray Strait).....	309
Labyrinth Group.....	327	— — (Mergui approach).....	412
— Islands.....	290	— Reach.....	187
Lacams Channel.....	212	— Rock.....	324
Laful Anchorage.....	274	— Sand (Bassein River).....	339
— Island.....	282	— — (Malpara River).....	184
Lah-chi Islets.....	420	Longstones Reef.....	376
Lakiataung, Mount.....	398	Loughborough Island.....	438
Lauksi, village.....	283	— Passage.....	438
Lalla Rookh Island.....	432	Love Point.....	187
Lallon Bar.....	219	— — Bar.....	187
Lama River.....	448	— Reach.....	187
Lambert Bay.....	329	Low Islet.....	314
Lampi Island.....	435	Lower Gaspar Lightvessel.....	203
Landfall Island.....	318	— Hastings buoy.....	352
— Rocks.....	318	Lewis Hill.....	320
Languliya River.....	165	Luchinarian Island.....	187
Laok Island.....	282	Lump Rock.....	421
Laouk Isle.....	282	Lunka Rock.....	428
Lapate.....	285	Lys Shoal.....	411
Lawrence Island.....	435	M.	
Laws Island.....	249	Mabesh Kalle Creek.....	221
Leda Point.....	280	Mackey Bank.....	322
Lekogon Pagodas.....	344	Macleods Island.....	426

	Page.		Page.
Macpherson Strait	291	Mahratta Rock	401
—— western approach	290	Mahurigaon	188
Madramakan Island	413	Ma-ing Island	416
Madras	130	Maingay Island	410
—— aspect	131	Maingy Island	410
—— city	135	Maipara Point	184
—— climate	137	—— River	183
—— coal and supplies	136	Maiskhal Channel	231
—— communication	136	—— Island	230
—— quarantine	137	Ma-i-tang	309
—— radio station	137	Maji Gyun	389
—— repairs	136	Malacca, village	284
—— time signals	137	Malancha River	215
—— trade	137	Malaytapu Island	290
—— weights and measures	113	Maliwun Hills	442
—— wharves	137	—— River	448
—— Harbor	131	Man Point	279
—— anchorage	133	Mandalay, city	368
—— ballast	133	Mangrove Bay	296
—— buoys	132	—— Island	325
—— cyclones	134	—— Point	315
—— depths	131	Manners Strait	289
—— directions	134	Manneru River	145
—— general directions	134	Mansurkota Hill	171
—— lights	131	Maonderu River	161
—— moorings	133	Marble Islands	431
—— pilots	132	Marcus Group	410
—— prohibited anchorage	133	Maria Port	424
—— regulations	132	Marjata River	216
—— storm and weather sig- nals	134	Marsak Shoal	312
—— surf	133	Marshall Channel	331
—— tides	135	Martaban, Gulf of	372
—— Observatory	137	Martin Rocks	338
—— Presidency	32	Martini Sands	239
—— general remarks	32	Masullpatam	149
—— minerals	32	—— anchorage	149
—— mountains	32	—— buoy	149
—— ports	33	—— climate	150
—— products	32	—— communication	150
—— rivers	32	—— directions	149
—— time	33	—— Light	149
Magarkhira Tanda Beacon	178	—— signals	150
Magwe	364	—— storm signals	150
Magygyun Island	260	—— supplies	150
Mahabalipur Point	129	—— tides	150
—— light	130	—— trade	150
Mahadani	193	Matla Lightvessel	213
Mahanadi Point	178	—— River	213
Mahandi River	178	—— navigation	214
Maharani Peak	282	—— tides	214
Mahendragiri Range	168	Mattabari Island	230

	Page.		Page.
Maud, Cape	282	Middle Passage	409
Maundrell Reef	412	— Reef	313
Maungdaw	237	— Rock	330
Maungmagan Bay	396	— Sands	231
— Passage	397	— Shoal	231
Mawdeng Point	337	— Strait	300
Mawvut Point	434	Middleton Light Vessel	204
May-gaunggaun Island	271	Midnapore District	58, 194
Mayo Bay	265	— canals	59
— Point	278	— climate	60
Mayu Point	238	— communication	59
— River	238	— products	59
— Spit	239	— railways	60
Meadows, Port	299	— rivers	58
Mean Sea Level	18	— trade	59
Medina Patches	422	Mile Stone Rock	270
Meghna Flats	217	Mill Point	353
— River	219	Mills Patch	265
— bore	220	Milo Island	276
— storm wave	220	Minbu, town	365
Menchal Island	276	Minerva Bay	314
Mengalon	361	— Ledge	304
Mercator chart	15	Minhla	364
Merghi Islands	416	Mita kua Bungalow	172
Mergui	415	Modah	370
— northern approach	416	Molly Island	435
— southern approach	416	Money Island	430
— District	78, 411	— Point	265
— climate	80	— Channel	347, 353
— communication	80	Monkhouse Point	312
— ports	80	Montgomery Islet	326
— products	79	Mopun Island	380
— rivers	79	Morland Rock	312
— trade	80	Morrellganj	216
— Harbor	413	Morrison Bay	429
— directions	414	Mosholt, village	280
— Islands	80, 406	Moskos Islands	397
— population	81	Mostyn Island	444
— products	81	Mouat, Port	323
— trade	81	Moulmein	333
Merk Bay	308	— Anchorage	381
Mermaids Passage	424	— port	382
Meroe Islet	277	— River	374
Metcalfe Island	449	— buoyage	380
Mid Terrible	250	— time signal	383
Middle Bank	224, 320	Mouse Islet	421
— Banks (Palk Strait)	117	Mraboong River	246
— Baronga	246	Muang Mai, town	456
— Button Island	306	Mud Volcano Shoal	246, 251, 255, 257
— Ground	257, 380	Muhammad Pau	192
— Hill	396	Munder Mohan	193
— Island	401, 441	Murray Point	274

	Page.		Page.
Mus, village	285	Negapatam, current	120
Mushroom Reef	316	— directions	119
Mussel Islet	409	— landmarks	119
Mutapolli Bank	146	— light	119
Myadaung, village	369	— quarantine	120
Myauk-kaung Island	422	— repairs	120
Myaungmya District	70, 341	— shoals	119
— climate	71	— storm and weather signals ..	119
— communication	71	— tides	120
— ports	71	— town	120
— products	70	— trade	120
— railways	71	— Shoal	118
— rivers	70	Negrals, Cape	272
— trade	71	Neill Island	302
N.		Nellore District	41, 141
Naaf Peninsula	235	— climate	43
— River	236, 237	— communications	42
Nabule Punkhun	396	— flora and fauna	42
Nagar	120	— geology	41
— anchorage	121	— minerals	42
Nagari Hills	140	— ports	42
Nagarkona Hill	221	— products	42
Nagiri Nose	140	— rivers	41
Nancowry Harbor	278	— trade	42
— Island	278	Nerbudda Shoal	262
— Ledge	308	New Channel	376
— Strait	302	— Island	402
Nankauri Island	278	— Shoal	267
— Strait	302	Nganabya Creek	240
Nanthakyun Island	266	Nga-Yot Bay	270
Narayananj	221	Nicholson Island	303
Narcondam Island	293	Nicobar Islands	81, 273
Narkumbau Island	247	— climate	82
Narsapur Point	151	— earthquakes	82
— town	151	— ports	82
Narsimhakonda Pagoda	143	— products	82
Nat Gyun	388	— rivers	82
Natnu	381	— trade	82
Nauri	189	Nilgiri Hills	190
Nauwi Rocks	401	Ninepins Rocks	438
Naval Point	278	Nishanbotu Hill	144
Navigation law, Siamese waters ..	443	Nizampatam	147
Navy Bay	297	— anchorage	147
Naza Island	436	— entrance	147
Nazum	367	— supplies	147
Nearchus Passage	428	— tides	147
— Rock	428	— trade	147
Negapatam	119	— Bay	146
— anchorage	119	Noakhali	219
— coal and supplies	120	Nondogi Island	251
— communication	120	Norman Point	222

	Page.		Page.
Panchpara Nud River.....	193	Pig Island.....	389, 433
Pandaw Rocks.....	260	Pillam Islet.....	432
Panella Islet.....	410	Pillar Rock.....	160, 271
Pa Wut Island.....	422	Pilot Charts.....	13
Papra Strait.....	455	— Island.....	187
— directions.....	456	— Reach.....	187
Paravanur River.....	125	— Reef.....	302
Parker Island.....	429	Piloting.....	25
Parkit-erema.....	304	Pilots Ridge.....	194
Parsons Point.....	273	— Lightvessel.....	194
— Rock.....	440	— tides.....	195
Pascoe Shoal.....	390	Pimple Hill.....	240
Passage Island.....	288	Pinjigyun.....	402
— Rock.....	241, 318	Pinnacle Rocks.....	408
Patakund River.....	178	Pippli Sand.....	193
Pataravakam Hill.....	129	Pirie Island.....	429
Patawtaung Hill.....	413	Pitt Islet.....	432
Patch, The.....	299, 376	Planes of reference.....	17
Patunga Beacon.....	222	Plantain Island.....	410
— Point.....	222	Plowden Point Beacon.....	180
Paw Kyun Island.....	239	Pluto Island.....	290
Payan Island.....	442	Poahat Island.....	283
Paye Island.....	434	Pocock Island.....	317
Pazundaung Buoy.....	352	Point Island.....	322
— Creek.....	359	Polarem Beacon.....	159
Peak Islet.....	412	Pollock Reef.....	438
Peaked Rocks.....	241	Pollok Bay.....	330
Peehee Point.....	330	Polly Island.....	421
Peck Shoals.....	290	Pondicherri.....	38, 126
Peepers, The.....	386	— anchorage.....	127
Pegu River.....	358	— climate.....	39
— bore.....	359	— coal and supplies.....	128
Pelorus.....	23	— communication.....	39, 127
Peni Kyong.....	246	— directions.....	127
Penner River.....	143	— landing.....	128
Pentakota.....	159	— lights.....	126
— River.....	159	— port regulations.....	127
Perforated Island.....	441	— products.....	38
Perka, village.....	284	— quarantine.....	127
Perseus Point.....	323	— railways.....	39
— Reef.....	282	— signal stations.....	126
Perseverance Point.....	293, 296, 314	— signals.....	126
Peter Scott Island.....	421	— tides.....	127
Peterson Rock.....	429	— town.....	127
Petrie Islet.....	326	— trade.....	38, 128
Phaeton Shoals.....	336	— winds.....	128
Phalein Hill.....	388	Pool, The.....	414
Phoenix Bay.....	295	Portland Point.....	386
Piara Rock.....	282	Portman Bay.....	289
Pia Sima, mount.....	449	Porto Novo.....	124
Pich laka chakan.....	308	— anchorage.....	124
Pigale Islet.....	419	— communications.....	124
Pigeon Islet.....	160	— directions.....	124

	Page.		Page.
Rat Islet	330	Sacramento Shoal	152
Rathedaung Town	240	Saddle Hill	313, 320
Rati Beacon	167	—— Island (Kyaukpyu Harbor) ..	249
Ray Hill	311	—— — (Mergui Islands)	425
—— Point	280	—— — (Pakchan River)	444
Red Crab Island	231	—— North Peak	313, 320
—— — Islet	438	Sadras	129
Reddle Beacon	180	—— Hills	129
Reef Island	247, 321, 400, 430	Sagaing Point	367
—— Point	279	—— town	367
Regu Shoal	233	Sagar Channel	203
Reid Point	278	—— Island	205
Reliance Shoal	250	—— — signal station	205
Renong River	447	—— Lighthouse	205
—— Town	448	—— Roads	204
Research Rock	253	—— Sand	203
Revello Channel	277	Sagu Island	259
Richards Island	438	Sahlundam Hill	166
Richelleu Rock	441	Sail Rock (Heywood Channel) ..	261
Robert Island	434	—— — (Nancoury Strait)	302
—— Scott Island	421	—— — (Whale Bay)	433
Robinson Shoal	267	Sailing Directions	12
Rock Islet	409	Saingbain Kieu	271
Rockingham Patches	190	Sakone Islet	419
Rocky Point (Bassein River) ..	338	Salan Island	438
—— — Beacon	254	Salang Island	454
—— — (Cheduba Strait)	253	Salu River	266
—— — (Gwa Bay)	268	Salween River	374
—— — (Port Cornwallis)	314	Sam Lem	456
Roe Bank	440	Samalkkon	367
Rong-at Bay	310	Sand Cay	538
Rosamund Shoal	303	Sandoway Bay	265
Ross Island	294, 422	—— District	67, 261
—— Sand	390	—— — climate	68
Round Cape	271	—— — communication	68
—— Hill	159, 269	—— — ports	68
—— Island	270	—— — products	67
—— — (Cheduba Island)	256	—— — rivers	67
—— — (Elphinstone Harbor) ..	309	—— — trade	68
Ruby Island	434	—— River	263
Runnymede Point	302	—— town	264
Rupadla Sands	231	Sandwip Channel	219
Rushikulya River	171	—— Island	218
Rusi Hill	162	Sandy Point (Cheduba Island) ..	256
Russell Island	439	—— — (Kalingupatam)	166
Rutland Island	289	—— — Light	166
		—— — (Little Andaman Is- land)	286
S.		Sanenya, village	284
Sa Island	413	Sangaslap Island	442
Saba Island	270	Sangu River	228
—— Rocks	270	Sanjib Peak	159
Sack Island	425		

	Page.		Page.
Santapilli Light	165	Sidney Island	431, 432
— Peak	164	Sildra Bank	194
— Rocks	165	Silver Island	433
Sargent Island	427	Simpson Shoal	390
Satara Reef	166	Sinclair Shoal	390
Satbala Sandhill	183	Singarayakonda Temple	145
Satellite Bay	279	Singaung Island	263
— Island	251	Single Rock	422
— Ledge	267	Singyat Island	264
— Patch	279	Sinma, village	270
— Point	281	Sir C. Malcolm Island	434
Satlugyun	401	— Charles Metcalfe Island	426
Sattarmukhi Channel	212	— Elijah Impey Island	449
— Sand	212	— Hugh Rose Island	301
Saul Island	439	— John Hayes Island	427
Saurin Island	423	— William Peel Island	303
Savage Island	241	Sirajganj	218
— Light	241	Sirrocca Bar	380
Sawi Bay	285	— Rock	381
Sayer Islands	441	Sisters, The	288
Searle Point	254	Sitakund Mountain	221
Second Observation Islet	431	Sitarparokia	237
Sellove Island	422	— Patches	238
Semiramis Bay	296	Sittang River	372
Sendong Hill	375	— — bore	373
Senkud Obelisk	178	Skluner Islands	439
Seppings Island	247	Slipper Island	331
Sesostris Bay	294	Smart Island	427
— radio station	294	Smith, Cape	309
— Shoal	293	Smyth Rock	300
Shahbazzpur Entrance	217	Sola Creek	193
— River	219	Sombrero Channel	276
Shahpuri Flat	235	— Point	276
— Island	235	Son and Father	435
Shalimar Point	208	— Islet	435
Shallinger Shoal	143	Sonadia Island	231
Shark Islet	322	Sonapur, port	169
Shearme Sand	390	Sound Island	311
Shin maw	400	Soundings	23
Shityangyun	402	South Andaman Island	293
Shoal Bay	298	— Arcot District	36
Shore Point	295	— — climate	38
Shortt Island	184	— — communications	38
— Beacon	185	— — minerals	37
— Light	185	— — ports	38
Shrub Rocks	416	— — products	37
Siam, money	113	— — railways	38
— weighs and measures	114	— — rivers	36
Sickle Island	187	— — trade	37
— Point	187	— Bank	320
Sidaw Point	392	— Bay (Great Nicobar Island)	273
Sidawtaung Hill	392	— — (Katchall Island)	277

	Page.		Page.
South Broni River	181	Stag Island	388, 391
— Brother	287	Stainer Rock	444
— Button Islet	306	Star Island	429
— Delay Shoal	237	Steep Island	436
— Direction Island	425	— Point	324, 432
— Hummock	245	— Shoal	436
— Island	407, 442	Stewart Island	312
— Islet	315, 397	— Sound	310
— Passage	340	Stoat Island	325
— — Island	429	Strait Island	307
— Reef	316	Subarnarekha, port	193
— Patch	330	— River	193
— Patches	221, 230	Submarine bells	17
— — lightvessel	221	Sudikonda Hill	159
— Peak	254, 394	Sugar Loaf Islet	322
— Reef	314	— Loaves	449
— Islet	323	Sugarloaf Hill	162
— Rock	251, 271	Sullivans Island	435
— Rocks	246, 408	Sundarbans	211
— Round Island	416	— house of refuge	211
— Sands	395	— District	60
— Sentinel Island	287	— — climate	61
— — Islet	435	— — communication	61
— Sharp Peak	267	— — products	61
— Shoal	386	— — radio station	61
— Spit	239	— — railways	61
— Terrible	251	— — rivers	60
— Travers Island	339	— — trade	61
— Twin	438	Sunk Rock	312
Southampton Road	252	Sunta Creek	183
Spike Hill	272	Suvarnamukhi River	142
— Island	300, 324	Swatch of No Ground	216
Spit Lightvessel	347	Swirl Rock	426
Spiteful Bay	279	Sylvia Island	426
— Rock	444	Syriam Flat	353
Squadron Rocks	248		
Square Rock (Middle Baronga Is-			
land)	246		
— — (Morrison Bay)	430		
— — (Stewart Sound)	311		
St. Andrew's Church	131		
— Group	440		
— David, Fort	125		
— George, Fort	131		
— Georges Channel	276		
— Johns Rocks	268		
— Lukes Islands	439		
— Martins Islands	237		
— Reef	237		
— Mary's Church	131		
— Mathews Island	439		
— Thomas Mount	130		

T.

Taan Islet	276
Table Island	331
— — radio station	332
— Islands	316
— Reef	316
Tadagyi Island	420
Tada Island	416
Tadanage Island	420
Tadma Bay	303
— Juru	303
Ta-erema	303
Taihlone Island	282
Tai naine Island	439
Takoa-te Island	288
Takua Pa	449

	Page.		Page.
Taku Rocks	442	Tenasserim River	418
Talo Kaicha Island	325	— village	418
— Murgu	322	Ten Degrees Channel	285
Tamalu, village	284	Teressa Island	282
Tamaprau River	455	Terribles, The	250
Tamarind Island	389	Tetulia River	217
Tangagyo chaung Islet	260	Thalia Shoal	334
Tangaro Island	249	Thames Point	253
Tango Islet	432	Thamihla Island	409, 416
Tang Pran River	453	Thanpo Island	419
Tanjore District	33	Thanze Creek	386
— — climate	35	Thararo Islet	316
— — communications	35	Thaton District	74, 373
— — geology	34	— — climate	75
— — ports	35	— — communication	75
— — minerals	35	— — ports	75
— — products	34	— — products	75
— — rivers	34	— — railways	75
— — trade	35	— — rivers	74
Tao boroga	324	— — trade	75
Tapir Hill	396	Thejaungtaung, mount	399
Tapping Point	296	Thetyagi Islet	416
Tara Lait	313	Thirthalmundl Beacon	152
Tarmugli Island	327	— village	152
Tar-mugu	305	Thitya Island	416
Tatat Island	283	— Islet	412
Tat Creek	237	Thombongyun	401
Taukopah Inlet	450	Thornhill, cape	319
— — directions	450	— Island	319
— Town	451	Three Points, Cape	456
Taungnyo Hill	235	Thullier, mount	273
Tauteramiku	323	Thumb Hill	269
Tavoy District	77, 394	Thyne Bank	268
— — climate	78	Tidal Streams	18
— — communication	78	Tide Tables	12
— — ports	78	Tides	17
— — products	78	Tillanchong Island	282
— — rivers	77	Tirmelwassel	123
— — trade	78	Tirumani Hill	129
— Island	406	Tiruporur Hill	130
— Point	400	Toba erema	308
— River	399	Toby Rock	388
— Town	405	Todd, Mount	239
Taylor Hill	319	Tokwekwong Island	256
— Patches	324	To-le-te-le	308
— Shoal	238	Torilla Island	441
Te-joma-de Island	288	Tounzoun Point	375
Temple Point	180	Tower Rock	427
— Sound	321	Tradikeli Hill	320
— Tree	181	Trak Islet	276
Tenasserim Island	408	Tranquebar	122
— Peak	408	— communication	122

	Page.
Tranquebar landing	123
— supplies	123
— trade	123
Travellers Bungalow	187
Tree Island	386
— (Heywood Channel)	262
— (Morrison Bay)	429
— Islet	317
— (Bell Passage)	444
— Summit	253
Trels Islet	276
Trifels Shoal	230
Trilby Island	316
Trinkat Champlong Bay	274
— Island	282
Tripalur Reef	130
Trotter Island	430
Tsheng Taung	375, 384
Tsing Island	435
Tucker Island	431
Tuft Island	323
Tummalapenta	144
Tundaha Obelisk	176
Tuni Hill	159
Turtle Islands	315
— Point	179
— Reef	315
— Rock	290
Tuson Hill	320
Twin Rocks	431
Twins, The	289
Two Fathoms Rock	304
— Hill Island	435

U.

Ucha, town	237
Umbrella Island	449
Una Island	430
Ung-chume Island	271
Unguan Island	262
Ungyaung Creek	250
Union Ledge	317
Upada Bluffs	162
— port	158
Upper Gaspar Lightvessel	204

V.

Vakalapudi Light	155
Vamsadhara River	166
Vanteyam Godavari River	152
Variation	27

	Page.
Vasishta Godavari River	151
Vellar River	124
Vera Island	434
— Shoal	434
Vestal Shoal	267
Vettar River	120
Vibart Shoal	270, 302
Victoria Island	443
— Point	442
— Harbor	446
Viper Island	296
Vizagapatam	160
— anchorage	161
— communication	162
— directions	161
— landing	162
— light	161
— repairs	162
— storm signals	161
— supplies	162
— tides	161
— trade	162
— winds	162
— District	48, 159
— climate	50
— ports	50
— products	49
— rivers	49
— trade	50
Vrudha Gautami River	152
Vupatteru River	143

W.

Wa Gyun	388
Walker Island	273
Waltair Point	162
— town	162
Ward Point	339
Wards Channel	213
Warning Rock	428
Warreo entrance	152
Warrington Reef	433
Wasp Bay	279
— Point	281
Waterfall Cove	422
Water Pagoda	375
Wattara	159
Wedge Island	429
— Point	299
— Rock	299
Well Hill	449
Wembaik Creek	260

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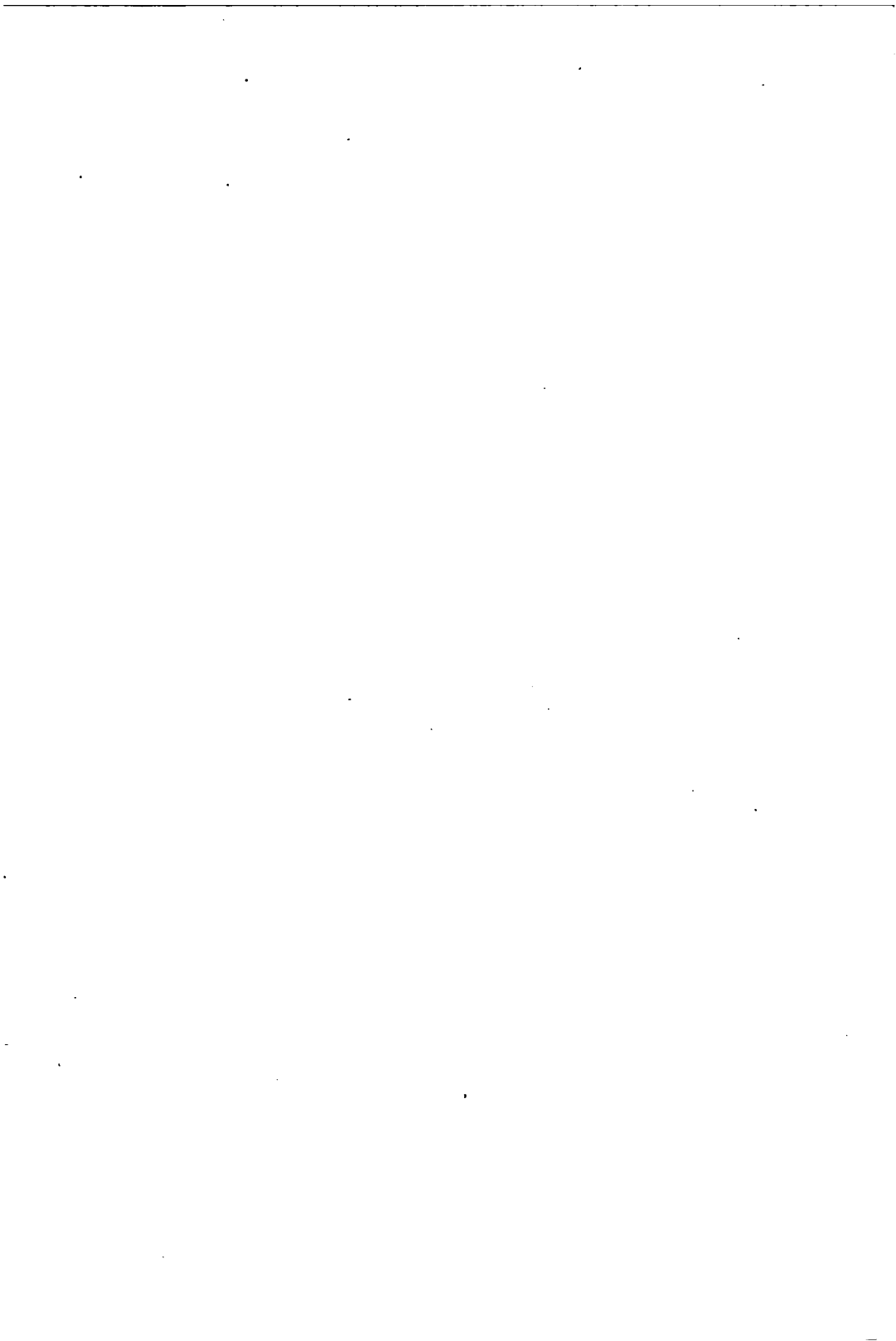
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